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U. S. DEPARTMENT OF AGRICULTURE.

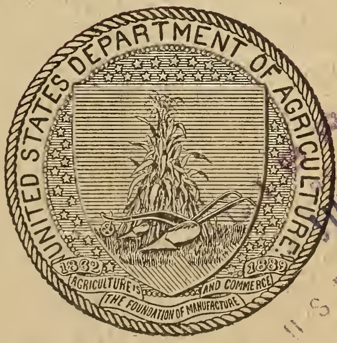
Report No. 73.

REPORT

OF THE

SECRETARY OF AGRICULTURE.

1902.



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CONTENTS.

	Page.
Weather Bureau	4
Bureau of Animal Industry	5
Bureau of Plant Industry	7
Bureau of Forestry	24
Bureau of Soils	29
Bureau of Chemistry	59
Division of Entomology	61
Division of Biological Survey	68
Division of Statistics	71
Office of Experiment Stations	71
Division of Foreign Markets	89
Office of Public Road Inquiries	90
Publications	92
The Library	94
Estimates and appropriations	95
Office of the Appointment Clerk	95
Exposition work	95
Magnitude of agricultural industry	96

REPORT

OF THE

SECRETARY OF AGRICULTURE.

To the President:

The educational work of the Department of Agriculture has grown in effectiveness since my last Annual Report. The opportunities offered to young men to fit themselves for special lines of experimental work under the immediate care of our most experienced scientists are being sought by greater numbers every year. The influence of the Department is extending through cooperation with the scientists of the experiment stations of the several States and Territories and the isles of the sea under our flag. The demands of these institutions for trained men to conduct research into so many fields of inquiry and of private individuals and companies for the best organizing and supervising ability to manage agricultural enterprises encourage students to prepare for doing this work.

The teaching of the science of agriculture and the sciences related to it is receiving more attention in the colleges instituted for this purpose, many of which in the past have neglected their full duty in this regard.

Research by the Department officials into the principles governing the growth of plants and the creation of new species by hybridizing to give varieties from which to select for new purposes has brought gratifying results. We have new fruits and grains of numerous kinds adapted to localities that have been needing them for many years.

We are helping people in many localities to an intelligent knowledge of their soils and of the most profitable uses to which they may be devoted. Results are showing the value of this service. The best sugar lands, rice lands, tobacco lands, truck lands, and lands best adapted to particular fruits, grains, grasses, legumes, and other crops are being discovered as certainly as any other unknown thing is brought to human knowledge for the first time.

Few of the plants of most value to our people are native to the United States. They are products of other countries and have been useful in their localities for long periods of time. Our various soils and climates are adapted to many things that have not yet been introduced to them. Department explorers are searching the Old World for whatever is valuable there and useful here, with results that are quite encouraging. Our aims are to help toward the production in the States and Territories of everything their soils and climates will permit, and to help our new island possessions to grow whatever products require tropical conditions.

Our growing commerce is accompanied with danger from invasion of animal and plant diseases and parasites calling for vigilance on the part of Department scientists to keep them out and to deal with them when they cross our borders, as they occasionally do.

My last Report showed that the Department was paying $12,600 a year for rent of buildings. It is now paying $21,700, and the amount will increase as the work increases. It would be good business policy to adopt a plan of building adequate to the future needs of the Department, and to authorize the erection of so much of it as would provide for the offices that are now housed in the city wherever room can be had. The sum necessary to provide the rent, at Government rates of interest, would be ample to begin with; besides none of the buildings now in use are fireproof, and we have materials that have accumulated in our laboratories, in addition to a unique library, that could not be replaced if destroyed by fire.

WEATHER BUREAU.

Forecast Warnings.

The past year affords gratifying evidence of the value of forecast warnings of the Weather Bureau in saving life and property. People of other nations express appreciation of our Atlantic weather forecasts. The universal appreciation of this service in giving ample warning of the approach of severe storms or hurricanes or of killing frosts is highly gratifying and affords ample testimony of the assertion I have made on previous occasions that the value of property saved from loss repays to the country many times over the cost of maintaining the Bureau.

Substantial increase was made in the distribution of daily forecasts through the rural free delivery, although efforts in this direction were circumscribed for want of funds for the purchase of necessary supplies. On August 1, 1902, there were in operation about 10,000 rural free-delivery routes, serving approximately 1,000,000 families. For the reason stated, only 105,000 families, served by about 1,000 routes, could be furnished with the forecasts of the Bureau. According to the estimates of the Post-Office Department, there will be in operation July 1, 1903, 15,000 routes, serving approximately 1,500,000 families, representing a population of over 7,500,000 people. The distribution of the daily forecasts of the Bureau should be made coextensive with the rural free delivery. This could be done on the basis of the Post-Office estimates for July 1, 1903, at a cost of about $100,000.

Wireless Telegraphy.

The experiments in space, or wireless, telegraphy were begun January 1, 1900, under the direction of the Chief of the Weather Bureau, and were continued during the past year. While much valuable information has been secured and a fairly satisfactory experimental system has been devised, I am not able to report such progress in the investigation as would justify the Department in dispensing with its coast telegraph lines or with the cables that connect certain islands with the mainland.

Storm Warning Equipment.

As far as funds would permit, the work of extending the equipment of steel towers and high-power lanterns of improved type at important storm warning stations was pushed energetically during the year by the instrument division. In all, 54 towers were distributed to storm warning stations.

The funds available were too limited to permit of the purchase of high-power lanterns and other accessories required by the towers.

Moreover, the first six months of the past year have been necessarily consumed in the manufacture, shipment, and installation of the towers. The matter of lanterns and accessories will therefore have to be supplied this year, and while provision for them has already been made, the storm-warning fund will permit of no considerable extension of the work, and we must of necessity confine ourselves to finishing up the work left over from last year. There are now 109 storm-warning and 9 special stations at which the steel towers have been installed. Of these, 48 need lanterns, and they will be issued as soon as delivered by the contractors.

Under the special appropriation by Congress for the purchase of sites and the erection of buildings for the use of the Weather Bureau at certain stations, buildings were erected at the following places, at a total cost of $23,932.53, namely: Atlantic City, N. J.; Hatteras, N. C.; Fort Canby (North Head), Wash.; Port Crescent, Wash.; Tatoosh Island, Wash., and Point Reyes, Cal. Under this appropriation, also, buildings were repaired and improved and supplies provided, at a cost of $17,279.03, at the following places: Bismarck, N. Dak.; Jupiter, Fla.; Kittyhawk, N. C., and Cape Henry, Virginia. The buildings at Port Crescent, Wash., and Jupiter, Fla., are still in course of construction, but will be completed within a few months. In view of the approval of this policy and of the economy to the Government of owning its own buildings, I recommended an additional appropriation of $50,000, which was duly granted by Congress, for the purchase of sites and the erection of not less than six buildings during the current fiscal year. The places selected for these new buildings are Yellowstone Park, Wyo.; Amarillo, Tex.; Modena, Utah; Key West, Fla.; Sand Key, Fla., and South Farallone Island, California. Owing to the difficulty in providing sites for the buildings at Amarillo and Modena, it will hardly be practicable to erect buildings there before next spring.

The crop service of the Bureau will be dealt with in a special report called for by Congress.

BUREAU OF ANIMAL INDUSTRY.

Inspection Service for Export Animals.

The act of Congress of August 30, 1890, provided for the inspection by the Bureau of Animal Industry of meats for exportation, and this was supplemented on March 3, 1891, by an act providing "for the inspection of live cattle, hogs, and the carcasses and products thereof which are the subjects of interstate commerce, and for other purposes." This law was amended by an act which took effect July 1, 1902, providing for the inspection of dairy products for export. Under these laws important service to the live-stock industry has been performed.

The total number of ante-mortem inspections was 59,158,648, being an increase over the previous year of 2,789,338. The cost of these inspections was 1.08 cents each. The number of post-mortem inspections was 38,903,625. The carcasses condemned numbered 61,980, besides 17,445 parts of carcasses.

The meat-inspection tag or brand was placed upon 19,694,665 quarters, 250,141 pieces, and 3,820 sacks of beef, 7,419,287 carcasses of sheep, 554,016 carcasses of calves, 1,253,083 carcasses of hogs, and 793,471 sacks of pork.

The meat-inspection stamp was affixed to packages of meat products that had received the ordinary inspection as follows: 7,166,490 of beef, 39,229 of mutton, 8 of veal, 15,835,520 of pork, and 638 of horseflesh, a total of 23,041,885.

The number of cars sealed containing inspected meat products for shipment to official abattoirs and other places was 64,730.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 32,744. Of beef there were 1,571,305 quarters, 19,728 pieces, 3,845 bags, and 1,582,549 packages, with a weight of 416,990,762 pounds; of mutton there were 85 carcasses and 26,942 packages, weighing 1,145,248 pounds; of pork there were 94,962 carcasses and 658,139 packages, weighing 188,360,011 pounds. These figures show a decrease from the previous year of 35,839,611 pounds of beef and 42,784,927 pounds of pork. There were 11 certificates issued for horseflesh, the export consisting of 638 packages, weighing 170,968 pounds.

The quantity of pork examined microscopically, which was exported, amounted to 33,681,229 pounds. This was a decrease of a little more than 2,000,000 pounds from the previous year, owing to a decreased demand for pork from those countries demanding inspection. The cost of this work per pound was 0.368 cent.

The value of the exports of animals and animal products for the year ended June 30, 1902, amounted to the large sum of $244,733,062. Of this amount, $44,871,684 was the value of the animals, $192,756,608 of the meat and meat products, and $7,104,770 of the dairy products. The total value of the exports of animal products was about $3,000,000 greater than the like exports of the previous year, but there was a decrease of nearly $8,000,000 in the value of cattle exported. This was due to the sharp demand for beef cattle in this country.

Of the 392,884 cattle exported, 295,346 were inspected, tagged, and certified as to health. The others shipped were from ports where inspection is not provided and is made to countries where a Government certificate of inspection is not required. Of sheep, 401,132 were inspected and 212,178 were certified for export; of horses, 19,990 were inspected and 10,975 certified for export. The value of the cattle exported was $29,902,212; of horses $10,048,046; of mules $2,692,298; of sheep $1,940,060.

The inspection of vessels for carrying live stock has been conducted with a view to the best possible service and the most humane treatment of the animals. The percentage of loss in ocean transit of cattle is now reduced to 0.13 for cattle, 0.89 for sheep, and 0.65 for horses.

The number of clearances of vessels carrying live stock was 837, which was considerably less than for the previous year—a condition due to the decreased exports of cattle and horses.

Inspection Service for Import Animals.

There were inspected and admitted from Mexico 65,213 cattle, 3,776 sheep and lambs, and 2,090 goats; also a few asses, horses, mules, and hogs. Through ports on the seacoast, horses not subject to quarantine were imported to the number of 2,283.

One of the most important duties of the Bureau of Animal Industry is to maintain strict quarantine at the ports of the seacoast in order to prevent the introduction of animal plagues. The efficiency of this service has been shown in the past, and it is a service by which the live-stock interests of our country are directly conserved. The live-stock growers demand and receive the most rigid inspection at these ports, for it would be no difficult matter to permit the introduction of diseases which might easily cost the live-stock growers many millions in direct losses, and at the same time the Government would be under heavy expense in efforts toward their eradication.

We imported from Canada 27,716 cattle, 148,313 sheep, 3,305 horses, and 5,356 hogs which were not subject to quarantine. There were also imported and quarantined 1,214 cattle, 231 sheep, and 33 hogs. Besides these there were quarantined animals of various species which were destined for menageries and zoological parks.

For the purpose of preventing the importation of cattle affected with tuberculosis a veterinarian has been stationed in Great Britain, whose duty it is to test with tuberculin all cattle over six months old which are destined for export to the United States. During the year 1,067 cattle have been so tested, of which 928 were passed and 139 rejected. These cattle were representatives of nine different breeds, those predominating being Hereford, Jersey, and Shorthorn.

Exports of Dairy Products.

Experimental exports of dairy products have been made to Japan, China, Cuba, and Porto Rico. This method of making known the better grades of these products has resulted in somewhat increased sales by merchants in San Francisco and New York and some parties elsewhere; but inadequate and unsuitable transportation facilities, the destructive climates of some of the markets referred to, and other unfavorable conditions prevent any rapid increase in this trade. The results indicate, however, that the markets of Japan may be further cultivated.

Under act of Congress of March 2, 1902, the dairy division of the Bureau inaugurated a system of inspection of dairy products offered for export, affixing stamps to the same, and certifying to the character and quality of the articles. Domestic prices, however, have been so high as to prevent any considerable export of high-grade goods other than condensed milk and cream.

Contagious Diseases.

The work of this Bureau with reference to contagious diseases of animals, which has been prominent from the time of its organization, has been continued. This work at present includes the control of Texas fever, blackleg, sheep scab, and maladie du coït, while scientific investigations are in progress to determine the nature and best methods of treating other important diseases, such as tuberculosis, hog cholera, and anthrax. The records show that 1,688,565 doses of blackleg vaccine were distributed during the year, and the reports of its use reduce the loss of cattle after using it to 0.51 per cent of those vaccinated. If we should eliminate from these reports those cattle which were presumably infected before vaccination, and also those which probably died because a mistake was made in the operation, the percentage of loss would be reduced to 0.44. These results indicate that the use of this vaccine has saved to the stock raisers many thousands of head of cattle and consequently a very large sum of money.

BUREAU OF PLANT INDUSTRY.

In accordance with the recommendations in my last report, Congress brought within the scope of this Bureau four additional lines of plant work, viz, the Arlington Experimental Farm, the investigations in the production of domestic tea, the work on foreign seed and plant introduction, and the Congressional seed distribution. It has necessarily required much time to perfect this reorganization, but everything in this direction is now practically complete and the nine main branches of the Bureau are being so conducted as to bring forth the very best work. Much of the success of any work in the Department depends, in the first place, upon good men, and, in the second place, upon giving such men responsibilities of a nature that will develop their best efforts. This policy is followed in the Bureau of Plant Industry, and as a result there is an earnest corps of workers, each knowing his duty and performing it with all the energy at his command. Owing to the fact that much of the detailed work connected with the reorganization was completed last year, it has been found practicable the present year to devote considerable attention to the development of new fields, a few of which may be briefly referred to here.

The nature of the work of this Bureau is such that cooperation with the State experiment stations is an important factor, and for this reason very close relationships have been established with station investigators in about thirty States. The work undertaken conjointly with these stations is of the most varied character.

Farm Management.

As the work of reorganizing this Bureau developed, the need was felt for properly coordinating all the varied lines of plant work in such a way that they could be brought directly home to the practical farmer and fruit grower in all parts of the country. To this end, I have approved the establishment within the Bureau of an office of Farm Management, which shall have for its object the bringing together in concrete form of all the facts developed in the Bureau as a whole, sifting the results, and applying them in a practical way where they will do the most good. To enhance the value of this work general studies have been inaugurated in the matter of securing facts regarding the way in which the best paying farms in the country are being managed, and what are the relationships of surrounding conditions, such as proximity to markets, ways of leasing or controlling the lands, soils, and climate, and the methods of farming followed. With the knowledge thus secured it will be practicable to lay out a working plan for a particular farm in a particular region, the object being in all cases to have such plans serve as object lessons for type regions rather than for individuals. In line with this plan there is now being undertaken in different parts of the South demonstration experiments for the purpose of showing the possibilities of more diversified farming.

With the cooperation of farmers, working plans are being devised whereby the present system of growing only one crop will be changed so as to secure more diversification, thus insuring greater profits and the building up of the fertility of the land. There are many thousands of acres in the South where the same system of farming has been carried on for years and where it would be a great advantage to inaugurate changes which would lead to the building up of the fertility of the soil and give broader opportunities to those handling the same. As a specific example of this work there is now being developed in the South, as object lessons, a system of what will be called "one-man" farms. These are small areas of land in the pine woods region upon which a system of farming is being developed of such a nature as to appeal directly to the class of farmers who must necessarily handle such land. Instead of a single crop, simple systems of rotation are being put into operation, and the question of the proper stock to keep is being considered, all being of such a nature that the work can be handled by one individual. In other regions, where the conditions are different, more elaborate plans are under way whereby considerable tracts of land which have for years been cropped to cotton are being arranged for a regular rotation, introducing stock as an element for the purpose of showing the possibilities of such diversification and its bearing on the welfare of the different communities.

Extension of Fruit Markets Abroad.

With the increasing production of special crops there is felt the urgent need for broader markets. This is particularly the case with perishable products, such as fruits and certain kinds of vegetables. There have lately been undertaken, in a limited way, some investigations having for their purpose the extension of the export trade and the improvement of the methods of handling these products for foreign and domestic use. Several experimental shipments have included summer apples, peaches, fall pears, and sweet potatoes—products in which an export trade is undeveloped; and winter apples, in which there is a large and increasing trade, but in which it is desirable to bring about improvements in the methods of handling and shipping.

The results so far obtained indicate that the first-named products may be landed in European markets in good condition if proper care is exercised in all of the operations from the orchard or field to the final destinations. A net return has been realized equal to, and in most cases in excess of, domestic values. It is shown also that the net return for a given fruit is largely influenced by the kind of package in which it is forwarded, and by the methods of packing and shipping it.

These preliminary investigations have already encouraged growers to ship some of these fruits in a commercial way and to adopt the suggestions brought out by the Department investigations. The fruit export trade needs careful investigation, both at home and abroad, in order that the methods of the American fruit grower may conform more closely to the foreign practices of handling and distributing our fruits and to the requirements of the foreign consumer.

I wish here to point out the necessity in work of this kind for a thorough and systematic study of the different foreign markets, in order that the American farmer and fruit grower may act intelligently in making shipments. To this end a plan is being devised whereby an experienced man will be sent to one or more of our most promising foreign markets to study all the prevailing conditions, and to secure and handle experimental shipments of fruits and vegetables, noting the condition in which various shipments arrive, the methods of packing which give the most satisfactory results, and looking after numerous other details which can be determined in no other way. Such an agent would also be in a position to secure valuable facts regarding the products with which we are compelled to compete, and would be able to point out methods by means of which we could best meet this competition.

To make this work still more valuable, the Department's agent or agents could do much toward enlightening the general public in such foreign countries in regard to the value of our products for general consumption. There is no reason why many of our fruits and vegetables can not be sent abroad and sold at a price that would place them within the reach of the average consumer, provided he was aware that he could obtain them, and knew something of their value as food. In other words, it seems that the time has come for decisive action in the matter of exploiting abroad such products as have been mentioned; and to accomplish this with the best results trained men, and men of good judgment, will be required. If sufficient funds are available, it is planned to inaugurate this work the forthcoming year in a limited way.

Plant Physiology and Pathology.

The practical utility of thorough scientific investigation of agricultural problems is nowhere better demonstrated than in the Department's work in the broad field of physiology and pathology. While the greatest scientific accuracy is demanded on the one hand in the study of the normal and abnormal or diseased condition of plants, on the other hand no effort is spared to make the knowledge thus obtained of practical use. Following are some of the results of the work of the past year.

PLANT DISEASES.

PEAR BLIGHT.

This disease, also known as fire blight or apple blight, is the cause of heavy losses annually. It has been especially severe for the past two years in the Southern and Pacific Coast States. The Department several years ago discovered improved methods of treating this disease, and during the past year a large field demonstration of the method was made in Texas in a place where the disease was so severe as to thoroughly test the treatment. This experiment, on a commercial scale, was entirely successful. Four to five thousand bushels of fruit were saved in the treated orchard, while in the untreated adjacent orchard the fruit was destroyed by the disease and the trees greatly injured. Similar demonstrations will be carried out next year in other parts of the United States.

LITTLE PEACH.

Some important discoveries were made during the year in regard to this rapidly spreading disease. In some respects it appears to be almost as serious a trouble as the dreaded peach yellows, and, as in the case of that disease, the Department recommends immediate destruction of the diseased trees. If this is promptly done the disease may be largely stamped out. No resistant stocks have yet been found. though careful search is being made for them.

BITTER ROT OF APPLES.

This disease is one of the worst with which the apple grower has to contend. For the past three years it has destroyed millions of dollars worth of fruit on the trees and millions of dollars worth in the hands of commission men. The method of treating this disease has, in the past, been only partially successful. An agent of the Department has lately discovered that the infection spreads from diseased canker spots on the limbs to the fruit. This discovery will enable us to much more thoroughly control the disease, if not to prevent it entirely. The spraying experiments this year have also been very successful.

BACTERIAL DISEASE OF ENGLISH WALNUTS.

One of the most important industries of southern California is the growing of English walnuts. For several years a disease has been gaining headway in the orchards and has caused great loss. The Department's experts on the Pacific coast have been studying the trouble and have been especially successful during the past year in improving the methods of combating it. While much still remains to be accomplished, a treatment has been found which will greatly reduce the injury done by the disease.

DECAY OF FOREST AND CONSTRUCTION TIMBER.

Rapid progress has been made during the year in the study conjointly with the Bureau of Forestry of the diseases of forest trees. Special attention has been given to the diseases in the great forest reservations, and practical methods of controlling some of them have been devised.

Recently a serious heart-rot disease of catalpa has appeared in some of the western catalpa plantations. A Department expert has studied this rot fungus, found out what it is, and has devised a method to protect the trees against it in the future. The importance of this is apparent. The planting of catalpa groves is increasing in several of the Western States. The wood is very durable, making good fence posts, telegraph poles, etc.

One of the most important subjects connected with the utilization of forests is increasing the durability of wood when used for construction. A careful study of the various methods of preserving wood was begun the past year by Department experts and much valuable information obtained. The organisms causing decay of fence posts, sills of buildings, railroad ties, telegraph poles, bridge timbers, greenhouse benches, etc., practically all belong to the group of fungi. The Department believes that cheap and effective methods of treating lumber so as to prevent this decay can be found, and considerable progress was made in this direction the past year.

PLANT BREEDING WORK.

DISEASE-RESISTANT CROPS.

The most practical way to fight disease is to use nature's method and get disease-resistant or immune plants. Striking success has been achieved by the Department experts in this line. The development of cotton resistant to wilt disease is now an assured fact and has been taken hold of by the planters on a large scale. Large tracts of land in the Sea Island district of South Carolina which had been abandoned on account of this disease were planted the past year successfully with resistant strains of cotton, and good crops secured. The discovery during the past year of a variety of cowpea—"Little Iron"—resistant to "wilt" and "root-knot" (two of the worst diseases of this important crop in the South) is a matter of great importance to Southern agriculture, where the need of leguminous crops for forage and soil improvement is especially felt. Thirty bushels of seed of this resistant variety were distributed during the past year.

Satisfactory progress was made during the year in securing varieties of cotton resistant to the Texas root-rot, and some evidence was obtained that varieties may be developed resistant to the dreaded cotton boll weevil.

BETTER UPLAND COTTONS.

One of the greatest needs in improving the cotton industry of the United States has been to secure a long-staple Upland variety which is of good quality and productive.

The long-staple Upland varieties at present existing are all of them rather light producers, and are defective in that the fiber is borne on fuzzy or tufted seed, which makes them difficult to gin.

The aim of the Department's experts has been to secure productive varieties with large bolls, easy to pick, with fine, strong lint from 1¼ to 1¾ inches long, borne on a smooth black seed. Many hybrids were made with this in view and the result has been successful beyond our expectations. Several varieties of the ideal type desired have been produced, having larger bolls, very productive, with long, fine fiber, borne on smooth black seeds. The experiments of the past year show quite conclusively that these varieties can be made permanent.

Egypt and South Africa are waking up to their possibilities in cotton production, and they are already endeavoring to get some of our experts to help them to develop the industry in competition with the United States. The only way we can continue to maintain our supremacy in the future is to develop and grow better and more productive varieties than will be grown by our competitors.

HARDY ORANGES.

The work of developing frost-resistant oranges was started several years ago, and the progress of the work has been reported from time to time. During the past season we have obtained the first fruits of these hybrids. These are intermediate in character between the Florida sweet orange and the hardy trifoliate, and have good, though few, seeds. There is therefore strong probability that from the seeds of these fruits we shall obtain numerous varieties with the qualities desired.

WHEAT BREEDING.

Several of the Russian winter wheats are superior to the American varieties; still there is room for improving on the Russian varieties. As a rule Japanese varieties are early maturing, while the better Russian sorts are late. Hybrids between the Japanese and Russian varieties have already been obtained having the good qualities of the hardy Russian sorts and the early ripening quality of the Japanese. Early varieties often escape the worst periods of drought and are less likely to be injured by rusts and other fungous and insect pests. Gratifying progress has also been made during the year in breeding rust-resistant varieties and nonshattering sorts.

NITROGEN-GATHERING BACTERIA.

Attention was called in my last report to the importance of nitrogen in the nutrition of plants, and the discovery of a new method of cultivating the bacteria which gather nitrogen in connection with leguminous crops was announced. This method has been perfected during the past year. The reason for the failure of former work in this line, both in this country and Europe, has been determined, and a new, simple, cheap, and thoroughly satisfactory method of growing and distributing the tubercle bacteria for all the important leguminous crops has been perfected. The nitrogen-gathering power of the bacteria grown by our new method is at least five times as great as the nitrogen-gathering power of the ordinary forms found in nature, and the new forms, instead of being restricted to certain legumes, have a much wider range of activity. Field tests on a large scale were started during the year, and advance reports from the cooperating farmers show extremely favorable returns from the use of these organisms.

Botanical Investigations and Experiments.

During the year the botanical investigations of this Bureau were pushed forward with vigor. Some of the more important results accomplished in this field are outlined below:

THE COMMERCIAL GRADING OF GRAIN.

A movement to secure an improvement in methods of inspection and toward greater uniformity in work of inspection departments of the large grain markets is now well begun, as a result of an organization of the chief inspectors of these markets. The interest manifested in this movement by all branches of the grain trade gives reason for believing that there may result from it a system of inspection and grading, maintained by the trade organizations, which shall be honest, efficient, and uniform throughout the country, and which shall insure to the farmer a premium for high quality of product, and to the consumer the quality of grain he demands and pays for. The Department is aiding this movement as much as possible by cooperating with these chief inspectors in working out simple and practicable methods for determining and accurately stating the quality of grain and studying causes and methods of prevention of deterioration of grain in storage and in transit.

AMERICAN AND EUROPEAN RED CLOVER SEED.

The study of the merits of red clover of American as compared with that of European origin has been continued, with the cooperation of a number of agricultural experiment stations in the clover-growing States. From the 1901 plantings the results were practically the same as those of the year before in the testing garden at Washington. The European clovers were not able to stand the hot and dry periods of our summer, but suffered badly from sun scald, and were generally of a much lighter color and less thrifty than those from our own seed. The same facts hold true for the plantings made this year, and it is evident that the European clover, unless it be some from the extreme north, is not adapted to the clover-growing sections of the United States.

NEW REMEDY FOR SHEEP POISONING ON THE STOCK RANGES.

The great stock ranges of the Northwest contain approximately one-third of the sheep in the United States, representing a value of more than $40,000,000. The owners of these sheep suffer an annual loss conservatively estimated at 1 per cent, or $400,000, from poisonous plants. During the past year the Department has continued its investigation of this loss and has succeeded in isolating poisonous principles from the species of camas and from one of the lupines, the two kinds of plants which, next to the loco weeds, cause the greatest percentage of loss in the Northwest. The antidote for poison camas announced by the Department in 1900, viz, drenching with a 1 per cent solution of permanganate of potash and sulphate of aluminum, while effective, can be successfully applied by one man to only a few sheep. Some remedy was demanded which could be more quickly applied when a large number of sheep are poisoned. Our physiological tests of the active principle of poison camas on rabbits and other small animals, subsequently verified with sheep, showed that considerable quantities of the poison passed from the system in the urine. A series of tests was then instituted with drugs that are known to stimulate the action of the kidneys. It has now been demonstrated that a combination of diuretin and caffeine is a satisfactory antidote for this poison; and as it can be given very rapidly by means of a hypodermic syringe, one man can apply the remedy to several hundred sheep in a few hours.

AN IMPORTANT STEP IN HEMP CULTURE.

More than nine-tenths of the hemp produced in the United States is grown in Kentucky, and at present prices it is regarded as second only to tobacco in profit as a farm crop. It yields a good profit there, notwithstanding the fact that practically no labor-saving machinery or improved methods of handling the crop have been introduced. The hemp is nearly all cut by hand, and after much laborious handling in the process of curing and retting it is broken on a hand brake. In Nebraska, where the industry is being established, a new and important step has been taken in cutting the crop with an ordinary mowing machine. A simple attachment, which bends the stalks over in the direction in which the machine is going, facilitates the cutting. The work is regarded as not much more difficult than that of cutting clover or alfalfa, and one man with a span of ordinary farm horses and a mowing machine that has a 5-foot or a 6-foot cutting bar will mow about 10 acres per day. The cost of cutting hemp in this manner is 50 cents per acre, as compared with $3 to $4 per acre, the rates paid for cutting by hand in Kentucky.

The hemp, after being mowed, is left where it falls until retted, except where it is especially heavy. In that case it is necessary to turn it to secure uniformity in curing and retting. It is then raked up and taken to the mill, where the fiber is extracted by means of a series of fluted rollers and beaters. By these methods hemp tow is produced nearly equal in value to Kentucky rough hemp, and at a total cost, exclusive of rent of land, of about $20 instead of $45 per ton.

THE UTILIZATION OF FLAX STRAW.

Efforts are being made to utilize the fiber contained in the thousands of tons of flax straw produced from the flax raised for seed in the Dakotas and Minnesota. Heretofore most of this straw has been burned to get it out of the way. Now large quantities, after being cut and thrashed in the ordinary manner, are subjected to a breaking process which produces a fiber of excellent quality for paper pulp and also a fair grade of fiber for textile purposes. During the past season satisfactory results have been obtained in the use of North Dakota flax for the manufacture of binding twine.

DEVELOPMENT OF THE SISAL INDUSTRY.

The demand for sisal for the manufacture of binding twine is rapidly increasing, owing largely to the advent of the corn binder. The sisal plant is very exacting in regard to the conditions under which it may be cultivated successfully, and, as the areas having the proper conditions for its growth are comparatively limited, it is of the utmost importance to our American consumers of binding twine, as well as to the fiber producers in our tropical territories, that land suitable for the growth of the sisal plant be utilized so far as possible. These facts have been accentuated by the high prices paid for sisal fiber during the past year. A brief investigation has been made of the sisal industry in the Bahamas, where the conditions are somewhat similar to those in Porto Rico. Some sisal plants from the Bahamas have been sent for trial to the Porto Rico experiment station at Mayaguez. There seems to be little doubt that the sisal plant can be successfully cultivated in limited areas in Porto Rico, as it is now being cultivated in Santo Domingo. It has been introduced into Hawaii, and the first commercial crop has been harvested there during the past season, the fiber produced finding a ready market at good prices in San Francisco.

THE MANGO AND ALLIGATOR PEAR IN PORTO RICO.

Reports are in preparation advising the extensive planting of superior varieties of mangoes and alligator pears in Porto Rico, to supply the increasing demands of the markets of our Eastern cities. That these fruits are not already as popular in the United States as bananas and oranges is due to the fact that there has been no adequate or regular supply of good quality. Porto Rico offers natural conditions very favorable for their culture, and improved facilities of transportation have simplified the commercial problem. Varieties much superior to those now grown for home use in Porto Rico have been found by representatives of the Department in Guatemala and Mexico.

CULTURE OF THE CENTRAL AMERICAN RUBBER TREE (CASTILLOA).

It is generally supposed that a continuously humid climate is necessary for rubber culture, but in southern Mexico it is obvious that an alternation of distinct wet and dry seasons is favorable to the production of rubber by Castilloa, which will permit a much wider use of this tree in our tropical islands than has appeared possible hitherto. The failure of some of the earlier experiments may be ascribed to planting in situations too uniformly moist. The tree will often grow luxuriantly where it will produce little or no rubber, as many planters have learned to their cost. Rubber is the most important vegetable raw material now imported for manufacture in the United States. The agricultural production of rubber is assured, and several millions of capital from the United States have been invested already in Mexican rubber plantations. The extent, however, to which these and similar enterprises in other countries can be made profitable depends on the solution of many new agricultural problems.

COFFEE SHADE.

The coffee industry of Porto Rico has been injured by the presence of too many shade trees in the plantations, owing to the belief of the planters that heavy shading is necessary. A study of the flourishing coffee industry of Guatemala establishes the facts that coffee of the highest grade can be grown entirely without shade, and that the diminution of shade lessens the ravages of the Central American leaf disease. The general opinion that the foliage and fruit of the coffee shrub are benefited by shade is erroneous, but the shading of the ground is often a cultural advantage. The nitrogen-collecting powers of leguminous shade trees have also contributed largely to the good effects commonly ascribed to shade, so that the selection of the best leguminous shade trees and soiling crops is of much importance to the coffee planter.

Pomological Investigations.

Fruit growing is the dominant type of agriculture in many parts of the country. Formerly it was an incidental feature of farm management. Now enough of certain kinds are grown for domestic use, and a large export trade has been developed. America grows fruit on an extensive scale in contrast with the small, garden-like areas of Europe. In America fruit is a common article of diet; in European countries it is a luxury. Europeans are beginning to know and value American fruits, but the principal consuming population of Europe is yet unacquainted with them. There are great possibilities in the export trade.

Domestic practices in culture and in methods of handling and marketing fruits are in need of improvement. Greater knowledge concerning the adaptability and distribution of varieties is urgent, and knowledge concerning the adaptability of European fruits to American conditions is desirable. Along these lines the pomological investigations of the Department have been largely proceeding since my last report, and in the office the great mass of scattered information on pomological matters and pomological collections is being systematized for practical use.

THE COLD STORAGE OF FRUITS.

Cold storage, or refrigeration, is a necessary adjunct to the rapidly developing fruit interests of the country. There is little known about the influences which govern the keeping qualities of fruits and vegetables. The Department is investigating this subject, and has strong support from fruit growers, fruit handlers, and warehousemen. The Bureau of Chemistry is cooperating with the Pomological Investigations in studying the chemistry of fruit-ripening processes. The investigation will require several years to secure general conclusions, but already important commercial results have been obtained.

"Scald," or a skin discoloration, is one of the serious storage difficulties with many apples. The cause is yet undetermined, but the investigations indicate that the susceptibility can be largely reduced by allowing the apples to become more highly colored or more mature than usual before picking. Such fruit also keeps equally well in storage. Pears and peaches, though usually stored with difficulty in a temperature of 36°, keep much better in a temperature not above 32°.

Fruit, like Bartlett pears and peaches, that ripens quickly after picking, and which is stored for a short time only, keeps best in open packages in which there is a free circulation of air which quickly reduces the temperature of the fruit; but winter apples, to be held for a long period, keep best in a closed package, which prevents evaporation from the fruit. The Department is investigating the influence of cultural conditions, methods of transportation, and systems of refrigeration, and the results seem likely to clear up many of the present cold-storage difficulties.

VITICULTURAL INVESTIGATIONS.

The viticultural investigations of the Department relate largely to the introduction of European table grapes into the Southern States, to various problems connected with the propagation of European and native grapes, and to the manufactured products of the grape.

In the experimental vineyard of European varieties at Earlton, Fla., established in 1899, several varieties are very promising and seem worthy of commercial planting in a restricted way. In this vineyard, which is on sandy soil, the distinct superiority of stocks of the Rupestris type over Riparia stocks has been demonstrated for the Vinifera varieties.

In North Carolina the experimental vineyard of similar varieties shows several promising varieties, though the results are less encouraging than in Florida.

An extensive experiment in bench and field grafting of Vinifera grapes has been begun to determine the relative congeniality of different varieties to different resistant stocks and the behavior of the grafted vines on various kinds of soils. This work is planned to have distinct bearing on the grape industry of the South and of the Pacific coast.

An investigation of the influence of dipping grape cuttings in water at different temperatures and for varying lengths of time upon their growth, and to destroy the Phylloxera, has demonstrated that the limit of safety was reached in a temperature of 50° C. with a five-minute immersion.

Investigations are also in progress relating to stocks that are resistant to the Phylloxera, and which are adapted to the grape growing of the Pacific coast.

The Department is also making a careful study of the methods of manufacturing unfermented grape juice and of its importance as a commercial product.

FRUIT DISTRICT SURVEY.

The adaptability of varieties to the conditions under which they are grown is a matter of fundamental importance, and no question is more often asked by a prospective fruit grower than "What varieties shall I plant?" The object of this survey is to determine the varieties of the different fruits best suited to the conditions where they are to be grown and to study the influence of conditions upon the behavior of varieties.

The funds available for this work have made it possible only to survey some of the more important sections of the Piedmont region of Virginia, the Blue Ridge section of Maryland, and a portion of a similar area as it extends into Pennsylvania. Much important data regarding the behavior of the numerous varieties of fruits already grown there have been accumulated. This survey is being extended to other fruit-growing sections as rapidly as possible.

In connection with this work an extensive cooperative system of phenological observations has been established. It is expected that these observations, extended over a period of several years, will throw light on several perplexing questions regarding the behavior of varieties and their adaptability to the various fruit-growing regions.

SPECIAL PROBLEMS IN POMOLOGY.

Investigations are well under way with pomological problems connected with the pecan industry, the peach industry, and the citron of commerce industry of the Pacific coast. On all these lines there is a large demand for reliable information, and the Department is preparing to issue publications covering them.

Grass and Forage Plant Investigations.

The value of the hay crop in this country exceeds that of any other crop except corn. When we add the yield of pasture lands to that of hay fields, the total exceeds the value of even the corn crop. Investigations of grasses and forage crops are therefore of vital importance to American agriculture. The investigations in this line during the past year have shown that the maintenance of soil fertility is intimately associated with the production of forage crops and their proper utilization on the farm. Those States which are noted for the production of such crops not only have maintained the original fertility of the soil, but they spend for commercial fertilizers less than 1 per cent of the annual value of their crops, while those States which pay least attention to forage crops have impoverished the soil and spend annually for fertilizers from 5 to 9 per cent of the total value of their crops.

LEGUMINOUS FORAGE CROPS.

The influence of leguminous forage crops in restoring fertility to the soil is well known. No system of agriculture can be indefinitely maintained without some crops of this character. From the earliest times clover has been the foundation of agriculture in our Northern States. But with each succeeding year the difficulty of securing a stand for this important crop increases, and there is a pressing demand for a suitable substitute for clover. The Department has undertaken to meet this demand by the introduction of alfalfa in the clover region. The success which has thus far attended our efforts in this direction is most encouraging. It has been demonstrated that alfalfa can be successfully grown in nearly all the Northern States. This work promises so much that we desire to push it vigorously during the coming year.

In our Southern States the cowpea is deservedly popular as a leguminous crop, both on account of its feeding value and its beneficial effect on the soil. But on account of its habit of growth this plant is difficult to harvest, either for hay or for seed. The Department has collected all known varieties of cowpeas in order to study the characteristics of each. We have undertaken to produce varieties that shall be free from the objectionable characteristics of those now grown, and have reason to hope for complete success. Other leguminous forage crops are being tested, both at Arlington Farm and at various places in the several States. Among these is a new and promising variety of alfalfa from South America that resists the rust which frequently attacks the common form, and which grows taller than the latter. As soon as seed of this variety can be obtained in quantity it will be distributed in those sections where there is most need of it.

GRASS GARDENS.

The grass garden on the Department grounds has been improved in a number of ways, and contains a large number of valuable grasses, legumes, etc. During the year this garden has been visited by a large number of people interested in agriculture, who have thus had an opportunity of observing many forage plants new to them. The public has shown a lively interest in this valuable display, which includes several valuable lawn grasses and ornamentals. An extensive grass garden was also maintained by this Department on the grounds of the Exposition at Charleston, S. C., and the correspondence received from Southern farmers relating to this garden shows that it was considered one of the most valuable features of our exhibit. It has been the means of introducing several new forage plants in the Southern States.

RANGE IMPROVEMENT.

The investigations in this branch of work have shown that the depleted Western ranges may be brought back to their original productiveness by proper methods of range management. Heretofore this work has been confined to small experimental areas. We have now progressed to the point where it becomes necessary to cooperate with stockmen in the actual management of selected areas of range lands. To do this it is necessary that we control the grazing of stock on such areas. To this end I repeat my former recommendation, namely, that action be taken by Congress giving you, Mr. President, authority to secure for the experimental needs of this Department such tracts of public range lands as may be necessary for the best interests of the work.

SOIL AND SAND BINDERS.

Along the Atlantic and Pacific coasts and the shores of the Great Lakes, as well as in many inland places, there are to be found extensive areas of drifting sand. These shifting dunes of sand frequently destroy farms, cover up farm buildings, and interfere with the operation of railroads. The Department is engaged in investigations having in view the covering of these sand dunes with vegetation to prevent drifting. Several species of plants have been found that can be propagated rapidly in this drifting sand. Several successful plantations of these have been made, and others are now being made. Some of the leading sand-binding grasses are grown on an artificial sand dune in the grass garden on the Department grounds, forming a very instructive feature of our outdoor exhibit. From the results thus far secured in other countries we have reason to hope that we may finally bring these barren and dangerous sands into useful grass and wood lands.

CROPPING SYSTEM.

This Department is collecting data concerning the systems of farm crops used in various parts of the country, in order to study the relation of such systems to the maintenance of soil fertility. The data already at hand show that in those sections where a one-crop system prevails the soil rapidly loses fertility, and there is a large and increasing demand for commercial fertilizers, while in those sections where a system of rotation of crops prevails, particularly a rotation including forage crops to be fed on the farm, the soil continually improves, and commercial fertilizers are not used except on small areas for special crops. I believe that this Department can do much for agriculture in this country by devising suitable cropping systems for those sections where present systems are unsatisfactory, and giving the farmer information about the best methods of utilizing his crops.

HORTICULTURE.

EXPERIMENTAL GARDENS AND GROUNDS.

As pointed out in my last report, the Experimental Gardens and Grounds under the reorganization have been made exceedingly useful as an aid to other branches of work carried on by the Bureau of Plant Industry and other Bureaus in the Department. With a view to still further increasing the value and efficacy of this work, investigations have been inaugurated having for their object the securing of information on crops which are cultivated more or less intensively in various parts of the United States. Special attention has been given to the cultivation of plants under glass and the elucidation of problems having a bearing on this important industry. The Experimental Garden is one of the oldest branches of the Department, and since this work was inaugurated a great many valuable plants have been accumulated. These have not been made as available for study as they might be, and for this reason plans have been put in operation whereby the various collections on the grounds and in the greenhouses will be brought together, properly labeled, and made useful for visitors and others who wish to study them.

A special feature of this work will be the development on the grounds of gardens of economic plants. It is planned to bring together a considerable number of the various native plants of the Eastern United States for the purpose of showing the possibilities of utilizing these plants in the simple decoration of the home and of schools. It is also planned to develop various collections of economic plants, such as drug and medicinal plants, and plants used in the arts and for numerous other purposes. As a further line of work for this branch of the Department, plans have been put in operation for securing and distributing seedling trees which have more or less historic interest. There are many historic trees in the vicinity of Washington and in the country at large, and it is believed that much good can be done toward arousing an interest in tree planting by distributing a limited number of these trees under proper direction. The seedlings, when grown, will be sent to schools in various parts of the country, and there will accompany each tree a concise statement setting forth the historic events connected with the tree itself and the growing of the seedling. The primary object is to keep alive patriotism and to encourage a love for nature and a love for home and the habit of tree planting.

THE ARLINGTON FARM.

The work on the Arlington Farm during the past year has been greatly increased. A considerable portion of the land has been drained, and during the year a thorough survey was made and the ground was platted, so that it was found practicable to begin the real work of experimentation. This farm, previous to its acquisition by the Department, was used for many years as a grazing area for horses and mules not in service, belonging to the War Department. In general it was fairly well covered with blue-grass sod, but many shrubs and trees had grown up to interfere with cultivation. The trees and shrubs were removed, the sod plowed and put into condition for the reception of cowpeas or buckwheat, according to the condition of the area, and the work was completed. About 40 acres of the land which in 1901 were planted in cowpeas were this year devoted to plat work. The plats are uniformly one-twentieth of an acre in area. Some 4 acres of such plats are devoted to nursery purposes, including seedling forest trees, while the rest is given over to experiments with vegetables, plant-breeding experiments, experiments conducted by the Pathologist and Physiologist, Pomologist, etc. In surveying and platting the land the location of barns and future buildings was determined upon, and a barn suitable for important needs is being constructed at the present time. With the facilities at hand it will be practicable next season to inaugurate quite extensive work.

Tea Growing in the United States.

The work on the growing of American tea was continued during the year at Pinehurst, Summerville, S. C., in cooperation with Dr. Charles

U. Shepard. Dr. Shepard now has at his place about 100 acres in tea gardens, and his factory is well equipped for carrying on work on a commercial scale and for accurate scientific experiments. With a view to bringing about a clear understanding as to the relationship of the Department to this work, a proper form of agreement has been prepared and entered into by the Department on the one hand and Dr. Shepard on the other. By the terms of this agreement the Department is able to secure the use of the extensive plant of Dr. Shepard for experimental purposes, and will profit by the results from the extensive work that he is carrying on. During the year careful attention has been given to methods of reducing the cost of the production of tea with very satisfactory results. Improved factory methods have also been put into operation, with the result that better grades of tea are now being turned out than ever before. To aid in this work, Dr. Shepard has secured during the year the assistance of an expert tea taster in New York, who has sampled his various grades and thus made it practicable to determine not only the kinds of teas which have proved of the highest quality, but the effects of different methods of picking and handling.

As pointed out in my last report, the yield of tea in Dr. Shepard's gardens last year was about 4,500 pounds, and this year there will be about 9,000 pounds of marketable tea. Some of the gardens have proved very prolific and profitable, while others have given very light yield of tea, having poor quality. All these facts, of course, will enable the Department to profit in further exploiting the work. With a view to increasing the interest in this crop, a tea farm will be established in Texas if suitable land and cooperation can be secured. Agents of the Department are now on the ground looking into the question, and the outlook is very favorable. Whether or not tea growing in this country can be made a commercial success will depend, in large measure, upon most rigid attention to the details connected with the field and factory work. It is not expected that any large profits will be made, but it is believed that by proper and judicious management sufficient profit will result to encourage the planting of the crop in many parts of the South, especially where there is cheap labor available. Proper labor, of course, constitutes one of the most important factors in this matter; but, fortunately, there are many places in the South where hands now idle might be turned to some use in this direction.

Congressional Seed Distribution.

In my last report attention was called to the fact that the distribution of seeds was required by an act very specific in its terms, and that it was my wish to carry out the will of Congress in a way that would result in the most good to the country. During the year rapid advancement has been made in the matter of improving all of this work, and it is gratifying to announce that under the system which is being put into operation little or no friction has resulted. The Congressional distribution for 1901–2 was the largest in the history of the Department, yet notwithstanding this fact all the seed went out on time. With a view to increasing the value of the work, particular attention was given to the distribution of forage-crop seed, cotton seed, tobacco seed, and seed of other special crops. In each case an expert was put in charge of a particular crop and was responsible for securing new, rare, or little known varieties, and the distribution of each variety in a locality where it seemed likely that benefit would result from its use. Very encouraging reports have been received as a result of this work, especially in the matter of cotton distribution, where a special effort was put forth to secure new varieties or varieties which were known to have value locally, but which had not been generally distributed. With a view to still further increasing the efficiency of the seed work, a number of new plans have been put into operation during the year.

The method of securing seed through a contractor has been abandoned, as it was never satisfactory, offering opportunity for inferior service, and, besides, working a hardship on the seed trade of the country—something the Department has no desire to continue. Under the new system the Department secures its own seed in the open market, and contracts only for the purely mechanical features of the work, such as the packeting of the seed and the mailing of the same. With a view to making this work of more value to the country and encouraging the legitimate seed trade, plans have been inaugurated whereby the Department will gradually substitute new or little-known seeds, such as specialties or novelties, for the more common sorts heretofore distributed. Seedsmen are now cooperating with the Department in furnishing these specialties and novelties, and the Department will distribute them possibly only one year, dropping them then and allowing the demand, if demand there be, to be met by the regular trade. Particular attention will be given in all this work to the distribution of special crops, such as forage, tobacco, cotton, sugar beet, cereals, etc. In the handling of these special seeds and plants the work of the plant-breeding laboratories will be utilized, and the requirements of different sections of the country will receive careful consideration, so that crops will be selected to meet the needs and requirements of the districts into which they may be sent.

FOREIGN SEED AND PLANT INTRODUCTION.

During the year the Department pushed forward the lines of work on introduction of foreign seeds and plants as rapidly as the means at hand would permit. In carrying on this work the various branches of the Bureau have contributed to the expert knowledge to be applied to the best handling of the crops.

Agents have been sent to the Orient with a view to securing information on crops particularly adapted to the South. Rice has received special attention, and in addition the question of forage crops suitable for this region was also kept constantly in mind. An agent visited India, China, and Japan, and secured many valuable introductions in the way of seeds and plants which will be useful in building up new industries. This work has been greatly aided by the generosity of Hon. Barbour Lathrop, who, at his own expense, has carried on extensive agricultural explorations during the year, assisted by Mr. David G. Fairchild, an agricultural explorer of this Department. Mr. Lathrop has secured and forwarded to this country a number of valuable plants, which are being handled by the Department's agents and by private individuals, to whom such plants have been sent direct by Mr. Lathrop. Particular attention was given to the introduction of the bamboo, which it is believed will prove a promising crop in sections of the West and South, where this plant is hardy.

In former reports attention was called to the efforts of the Department in establishing date growing as an industry in this country. Considerable advance has been made in this direction during the past year, a large shipment of young date trees having been received from Mr. Lathrop. They were planted in the large cooperative date orchard established by the Department in Arizona. This orchard now comprises about 11 acres and contains 580 imported trees, besides 80 native seedlings. Another important introduction during the year through Mr. Lathrop's efforts is the Egyptian or berseem clover, which is very valuable for certain portions of the country as a soil reclaimer and enricher and as a forage plant. The continued fertility of portions of the Nile Valley which are annually overflowed is largely due to the nitrogen-gathering properties of this plant.

Agents have also been sent to Algeria, Egypt, and other parts of Africa for the purpose of studying the irrigated crops of these regions, and also the crops which are particularly adapted to alkali soils. These agents have secured many valuable facts which will aid the Department in its extensive studies of the plants of our own arid and semiarid regions. With a view to securing additional forage crops and cereals from Russia and adjacent countries, an agent was sent to those regions in the early part of the year. The securing of forage crops, particularly the various kinds of Turkestan alfalfa, was the primary object of this visit; although some attention was given to obtaining varieties of fruits and cereals adapted to the dry regions of the Northwest.

MACARONI WHEAT.

The importance of the introduction and establishment of macaroni wheat in the United States, to which attention was directed in my last report, has been amply demonstrated by the results of the past year. We estimate that about 2,000,000 bushels have been harvested this season, but this will not meet the demand for it coming from all quarters. New mills are being built to grind it and old mills have been modified in order to handle it, and it now has its definite grade like other wheats in the Northwestern markets. It yields from one-third to one-half more than the other standard wheats in the same locality throughout the Great Plains region. Furthermore, it extends the wheat area much farther westward over districts of great extent, where it was not considered possible to grow wheat before, owing to light rainfall. The macaroni made from this wheat is pronounced by experts to be equal, if not superior, to the imported product, so that the success of this industry is assured.

WINTER WHEAT INTRODUCTION.

The results of the past year indicate that the winter wheats introduced and tested by the Department are likely to prove of as great, if not greater, value than the macaroni wheats. Four or five varieties obtained from east and south Russia are much more hardy than any varieties now grown in this country, and will extend the winter wheat area several hundred miles north and some distance farther west than at present. This means an increase of 5 to 10 bushels per acre over the standard spring wheats now grown in the same localities.

Quite valuable results have also been secured in the introduction of Swedish oats, proso or broom-corn millet, malakhof, sugar corn, and a number of other Russian crops. There has been rapid advancement during the year in the rice-growing industry, largely through the efforts of the Department in the introduction of new forms and the obtaining of information from abroad bearing on the methods of handling the crop and preparing it for market. Particular improvement has been made in the rice-growing regions of Texas and Louisiana, where the work of the Department has yielded the most striking results. In former reports attention has been called to the great value of this work to the two States named, and such has been its development that at the present time the rice production in this country about equals the demand.

The Jordan almond is another successful introduction during the year. There are about 5,500,000 pounds of almonds grown in California, but many pounds are still imported from Spain for the reason that the California nut is not equal to the best imported kind, known as the Jordan. During the year buds and scions of this variety have been secured and sent to California, and it is certain that in a few years California-grown Jordan almonds will be on the market.

A special effort was put forth during the year to secure alkali-resistant crops, particularly alfalfas and cottons. Seed of the Turkestan alfalfa has been obtained and is now on the way to this country, and will be distributed, under proper direction, during the year. Seed, also, of a number of alkali-resistant cottons has been obtained in Algeria and Egypt, and steps are being taken to place these seeds where the conditions are such as to make their success a valuable adjunct to certain parts of our Western country.

As a means of further systematizing all of the work connected with the distribution of seeds and plants by the Department, and the introduction of the same from foreign countries, plans are being perfected for establishing in a number of places in the country testing gardens, which will enable the Department to work out a number of important problems connected with these investigations. It has been found by experience that the promiscuous dissemination of seeds, many of which are often of great value, does not give in all cases satisfactory results. It is highly important in all such cases to be able to determine definitely where such plants and seeds are likely to prove most successful. After this is known it is still necessary to convince farmers or fruit growers of the feasibility of growing the particular crop. Even then the work is not finished, for although the crop may be grown readily, the question of a market must be considered.

Suitable testing gardens, conducted possibly in cooperation with some of the experiment stations, but under the direct control of the Department, will be of great value in further continuation of this work. Such gardens may be used for the purpose of standardizing the various varieties of vegetables now being offered by the seedsmen throughout the country. There is at present a great deal of confusion regarding varieties of vegetables, and while the work of breeding is growing apace it will be well worth while to fix the types of varieties and disseminate better strains of standard sorts. If the Department would set a high standard in this matter it would probably result in a great diminution of the indiscriminate renaming of varieties and in the introduction of such as are new only in some slight respect. It is obvious that work of this kind to be of the greatest value must be conducted under very careful conditions and be carried on in a sufficient number of regions to get results which will be of real value.

BUREAU OF FORESTRY.

On July 1, 1901, the Division of Forestry became a bureau. It has therefore completed its first year under the new form of organization.

The results obtained have amply justified the change and the increased appropriation which accompanied it. Interest in forestry and a perception of its possibilities as the means of making productive a great national resource have developed so swiftly in the United States that the discrepancy between the capacity for public service of this branch of the Department of Agriculture and its opportunities was never so great as it is now.

During the past year the Bureau of Forestry has notably increased the store of knowledge on which all forestry depends, and has made large gains in introducing practical management of forests, both of public and private ownership. Its field work has engaged 162 men, and has been carried on in 42 States and Territories.

The forest work of the Department of Agriculture has hitherto proceeded as rapidly as the scanty means of forest education would supply men, and its growth has been normal and safe. In view of the greater product of the forest schools and the immensely growing demand upon its services it might hereafter safely increase its rate of progress. To check the growth of the Bureau of Forestry at this time will likewise check the spread of public sentiment in favor of forest protection. It will dull the desire of forest owners, applicants to the Bureau for assistance, some of whom have already waited for their turn until their patience is almost exhausted. It will dampen the willingness of young men of the right stamp to make forestry their profession, because they look forward with practical unanimity to the Government service. A single frost which would pass over a mature tree without effect will often injure and retard for years the growth of a healthy seedling. I conceive the Bureau of Forestry to be in precisely that situation.

Organization of the Bureau.

The work of the Bureau of Forestry is organized along four lines: Forest management, forest investigation, records, and tree planting.

Forest Management.

The Bureau of Forestry exists to secure the best management of the forests of the United States in the interests of the whole people. This involves not only the development of a science of American forestry, but also the general introduction of conservative methods in handling forests of private ownership.

The Division of Forestry offered in October, 1898, to give advice and assistance to forest owners desirous of introducing conservative management. The response to this offer was immediate, and has grown steadily in volume. During the last fiscal year 37 applications were received, asking advice for the management of nearly 2,000,000 acres of forest lands. Altogether the advice of the Bureau has been asked, since its offer in October, 1898, on 4,709,124 acres.

The working plans of the past year are in the nature of solutions of seven typical and widely differing forest problems. These problems are:

Management of a Southern Appalachian forest, containing a great variety of trees, mainly hardwoods, in a somewhat inaccessible region, where only the most valuable species can be lumbered at a profit and where special measures are necessary to assist their reproduction and to prevent the progressive deterioration of the forest as the best woods are cut out. Fire protection, at a cost which is not prohibitive from a business standpoint, forms one of the important questions involved.

The tract studied has an area of 110,000 acres, and lies in Polk and Monroe counties, Tenn.

Management, in conjunction with coal mining, of a tract of mixed softwoods and hardwoods, containing 50,000 acres, in Scott, Campbell, and Anderson counties, Tenn. Silviculture, contract lumbering, transportation, and protection from fire are the more important points studied.

Management of 60,000 acres in Beaufort and Hampton counties, S. C., on which the most important commercial species is Longleaf Pine. Fire, lumbering, and turpentine orcharding have seriously injured the forest, and the consideration of first importance is a method of treatment which shall restore it to full productiveness while yielding a fair return on the value of the land. The conditions are typical of much of the Southern Pine Belt.

Management of 10,000 acres of fine hardwoods on Grand Island, Michigan, with an accessible market, a high price obtainable for the product, and consequently an exceptionally good opportunity for paying forestry.

Management of 15,000 acres in Herkimer County, N. Y., composed equally of cut-over and virgin forest. The most important timber tree is here, as generally in the Adirondack region, Red Spruce, and the chief object of the working plan was to provide for the reproduction of this species and to suggest such changes in present methods of lumbering as will give immediate and good returns from the forest and at the same time will insure a profitable future yield.

A somewhat similar problem, but in a different locality, was that presented by a tract of 275,000 acres in northwestern Maine. Field work was completed during the year on 150,000 acres of this tract, timbered mainly with Red Spruce and Balsam, of which the former, as commercially the more valuable of the two, should be favored as the source of subsequent crops.

The last tract on which field work was completed during the year was one of 15,000 acres near Arden, N. Y. The forest consists of second-growth hardwood and is for the most part in poor condition. The working plan advises a system of thinnings by which the condition of the forest will be improved and which will at the same time yield good returns in firewood.

The total forest area now under management in accordance with working plans prepared by the Bureau of Forestry is 372,463 acres. Material for a number of new working plans is now being gathered. Especially notable is the plan in preparation for a tract in southeastern Texas which comprises an area of 1,250,000 acres and is the largest private holding of timber land in the United States.

By request of the Secretary of the Interior for advice in the management of the national forest reserves, which now include 60,162,525 acres, the Bureau of Forestry became the official adviser for these reserves in matters of forest policy. The making of working plans for the reserves has continued during the year. Field studies have been carried on in the Prescott, the Priest River, and the Big Horn reserves, and a preliminary examination was made of the San Francisco Mountains Reserve. A similar request from the Secretary of War, made during the last fiscal year, has placed the Bureau in the same relation toward the military wood and timberreservations, eight in number, with an area of 117,468 acres. Of these, that at West

Point, containing 2,000 acres, has been examined, and a working plan for its management will soon be prepared.

In accordance with the request of the Secretary of the Interior, an examination has been made of the forest lands within the Lac Court d'Oreilles, the Bad River, and the Menominee Indian reservations, in Wisconsin, in order to recommend measures for the conservative lumbering of the timber they contain.

Forest Investigation.

The studies of commercial trees made during the past year include White Pine, Red Pine, White Oak, Scarlet Oak, Red Oak, and Aspen, in Michigan; Sugar Pine in California; Balsam in Maine; White Oak and Chestnut Oak in Tennessee, Kentucky, and Missouri; Western Yellow Pine in Arizona, and Lodgepole Pine in Wyoming and Montana. Previous studies of the Longleaf and Loblolly pines, of the Sierra Big Tree of California, and of the Bristle-cone Fir in southern California were completed and reports prepared on Western Hemlock and the Pacific Coast Redwood.

Studies of the growth and possibilities of New England second-growth hardwoods were carried on, and an investigation was begun of the distribution and the conditions necessary to the best development of the trees comprising the eastern Missouri and Arkansas swamp forests.

Studies of the forest and its industrial relations were made in the States of Michigan, Kentucky, Ohio, Texas, New Mexico, Arizona, South Dakota, Wyoming, Montana, California, and Iowa. Some of the questions involved were the present and future timber supply, forest fires, and the relation of the forest to stream flow, irrigation, and grazing.

Descriptive studies were conducted in cooperation with the United States Geological Survey of about 3,000,000 acres of the Sierra Forest Reserve and of the region in the Southern Appalachians, within which it is proposed to establish a national forest reserve.

In cooperation with the Bureau of Chemistry, investigations have been undertaken of native tan extracts and their comparative values in tanning, of Philippine gum products, and of possible additions to the present list of native woods suitable for the production of paper pulp.

A cooperative study of insects which injure the forest was begun with the Division of Entomology.

It is highly gratifying that the efforts which the Bureau has been making to discover a less injurious method of turpentine orcharding than that hitherto employed, and to which I made reference in my last report, have been successful, and that the way is apparently open for the general introduction of an improved method which will be of notable value in maintaining the source of the turpentine industry.

Tests of the durability of treated and untreated construction timber and railroad ties have been continued, in cooperation with the Bureau of Plant Industry. The enthusiastic assistance which has been received from railroad companies has demonstrated their appreciation of this valuable work.

In cooperation with the Bureau of Chemistry, and as the result of a widespread and urgent demand, the Bureau of Forestry has taken up the series of tests to determine the strength of the principal merchantable timbers of the United States, which were discontinued in 1896.

RECORDS.

The enlargement of the Bureau's quarters, which took place during the year, made possible for the first time the proper equipment of a library and the transference thither of the entire collection of forest literature from the Department library. This has given the Bureau a large, easily accessible working and reference library. The photographic collection now numbers over 6,000 prints, and a well-equipped photographic laboratory has been installed.

TREE PLANTING.

The work of the Bureau in tree planting for the last year has been chiefly notable in the conspicuous progress made in extending cooperative planting, in the creation of the first reserves for forest planting on Government lands in a region that is now unproductive of timber, and in the successful initiation of measures to control, by means of planted forests, the shifting sand dunes on both the Atlantic and the Pacific coasts.

In tree planting as in forest management the Bureau has sought, as the only method by which the desired end could be attained on a broad scale, to enlist the interest of the private landowner. Circular No. 22, issued July 8, 1899, offers cooperation in the work of planting forests similar to that previously made for forest management. Up to the close of the last fiscal year 262 applications for assistance had been received, nearly 200,000 acres had been examined, and 224 planting plans, covering about 6,400 acres, had been made. Of these, 51 plans for about 3,400 acres were made during the past fiscal year, and 83,597 acres were examined.

These figures, however, by no means cover the actual accomplishment of the Bureau in introducing forest plantations on private lands. The plans made are for 172 localities, in 29 States and Territories. Not only does the example set by each plantation made affect the whole neighborhood, but there has also been in many cases a public agitation of the question of tree planting, with local meetings addressed by the agents of the Bureau. Extensive planting on other land than that for which plans were made has frequently followed. Plantations of this kind will be of very considerable economic value in many States of the Middle West by furnishing local supplies of firewood, fencing, telegraph poles, and railroad ties, besides providing wind-breaks and other protection.

The success of economic tree planting in many scantily timbered or treeless regions of the Middle West is now assured. This means enhanced prosperity for these regions. A local timber supply is a matter of decided importance to the farmer, who needs cheap fuel and fencing. As a result of the Bureau's work, thriving plantations now exist in the Dakotas, Nebraska, Kansas, and Oklahoma, as well as in the older States of Iowa, Illinois, and Indiana.

In New England particular attention has been given to the possibility of profitably planting cheap land with white pine. The supply of this highly useful timber tree has been greatly diminished in the Eastern States. If it can be brought back as a paying forest tree under management, the benefit will be one in which both the landowner and the timber-consuming public will share. So encouraging has been the outcome of the examination of this question by the Bureau that many owners of denuded lands are restocking them with white pine.

The Proposed Appalachian Forest Reserve.

In my report on the Forests and Forest Conditions of the Southern Appalachian Mountain region, which has been printed along with your message to Congress on this subject, of December 19, 1901, I discussed briefly the rapid rate at which the forests on these mountain slopes were being removed, and the extent to which the resulting floods were destroying agricultural lands and other property along the streams rising in that region. In that report I stated that the damages resulting from these floods during the year (1901) "approximated $10,000,000, a sum sufficient to purchase the entire area recommended for the proposed reserve."

Subsequent examinations have shown that during the few months following the date of that report the flood damages on these streams, extending across eight different States, aggregated $8,000,000, making a total of $18,000,000 during the twelve months ending in April, 1902. These examinations also show, as additional results of the deforestation of these mountain slopes, (1) that the water powers along these streams, which have an aggregate annual value of $20,000,000 as a basis for manufacturing enterprises, are being gradually but certainly destroyed through the increasing irregularity in the flow of the streams; (2) that the soils which are being washed down from these mountain slopes are rendering annually less navigable the Ohio, the Tennessee, the Mississippi, and other rivers of these Southeastern States; and (3) that the rate of land erosion on these mountain slopes from which the forest cover has been removed is now as great in a single year as it was during ten centuries while these slopes were covered with primeval forests.

A bill providing for the establishment of the forest reserve recommended in my report is now pending before Congress. With an increased realization of the importance of this measure I reproduce here the concluding paragraph of that report:

> The preservation of the forests, of the streams, and of the agricultural interests here described can be successfully accomplished only by the purchase and creation of a national forest reserve. The States of the southern Appalachian region own little or no land, and their revenues are inadequate to carry out this plan. Federal action is obviously necessary, is fully justified by reasons of public necessity, and may be expected to have most fortunate results.

BUREAU OF SOILS.

The organization and work of the Bureau of Soils has been essentially along the same lines as heretofore, with the addition of an important line of work in the division of soil management. Attention has been given, as heretofore, to the administrative work, the soil survey, the tobacco investigations, drainage investigations, and the laboratories maintained in support of these several lines of field work. The wisdom of Congressional action in converting the Division into a Bureau and increasing the appropriation has been shown in the amount of work done and in the appreciation of this work from various sources. The soil survey, particularly, has been greatly extended, and the division of soil management, although merely started during the year, gives promise of some more important results than have been achieved in soil investigations for some time past. Prof. Franklin H. King, formerly professor of agricultural physics at the University of Wisconsin, has taken charge of this line of field work. He is considered peculiarly fitted for this place, and his appointment has been very generally commended.

During the year Mr. M. L. Floyd, the tobacco expert who had done so much to make successful the tobacco investigations of the Bureau, severed his connection with the Department to become general manager of a tobacco corporation organized to grow the shaded Sumatra tobacco in Connecticut, an industry established by this Department. In his new position Mr. Floyd receives far greater remuneration for his services than the Department could afford to pay, in view of the salaries paid to others by the Government.

The interest in the work of the Bureau of Soils is growing, and the demands for work in different parts of the country are increasing, as evidenced by the liberality of Congress in enlarging the appropriation and by the many requests received for the extension of the different lines of investigations. The Bureau of Soils now has a force of over 100 persons, 75 of whom have had a scientific training. It is believed that the results of the work in showing the conditions and resources of the soils of the country and in giving the people precise and accurate knowledge regarding the possibilities of the soils justifies fully every expenditure that has been made and every recommendation that will be made for the further extension of the work. With the fierce competition for commercial supremacy now operating, every particle of information bearing upon the natural resources of the country which will in any way tend to increase the production of our present crops or to develop new methods or build up new industries is of the utmost value, especially if, as in this case, the people are inspired with sufficient confidence to heed the advice of the Department and to take advantage of its work.

Cooperation with State Institutions.

During the year this Bureau has cooperated, as far as possible, with State institutions, including experiment stations, boards of agriculture, and geological surveys; also with Bureaus and Divisions of this Department, as well as with other Departments of the Government. Such cooperation has been particularly close with the North Carolina department of agriculture and with the Illinois experiment station, both of which institutions have contributed money toward the expenses of the soil survey in their respective States. In other States the cooperation has been just as cordial, but the institutions have not been able to render financial assistance. Their advice has been sought and given wherever possible in arranging for and in the carrying on of the work, and the work has been done, as far as possible, with the ultimate object of being of service to the State institutions in the prosecution of more detailed work. The Utah experiment station has cooperated in the line of drainage investigations and has contributed valuable assistance and advice in the work that has been started at Salt Lake City. The Connecticut experiment station and the Pennsylvania experiment station have continued their cooperation in the tobacco investigations with credit and profit to all of the institutions concerned.

The Bureau of Soils, through its laboratories, its soil survey, and its other lines of investigation, has cooperated with and has helped other Bureaus and Divisions in the Department, and has cooperated with the War Department in furnishing an assistant to organize a soil survey in the Philippine Islands, and in furnishing assistants to inspect the soils of some of the military posts and to advise as to the treatment in the establishment of parade grounds, a matter which is of considerable importance, involving the expenditure of large sums of money where the natural soils are not suited to the formation of a permanent sod.

Progress and Cost of the Soil Survey.

The area surveyed and mapped during the fiscal year was 14,541 square miles, or 9,306,240 acres, and the area previously reported as having been surveyed was 8,082 square miles, making a total of 22,623 square miles, or 14,478,720 acres. This work was carried on during the year in twenty-five States and Territories and in Porto Rico.

The following table shows the total area surveyed during the fiscal year 1902, together with that previously reported, in each of the thirty States and Territories in which the soil survey work has been carried on. This work has been uniformly done on a scale of 1 inch to the mile, and the maps have been published or are ready for publication. This table does not include any areas in which work of reconnoissance merely has been done, but only areas in which actual soil surveys have been made and soil maps prepared.

Areas surveyed and mapped during fiscal year ended June 30, 1902, and the areas previously reported.

State or Territory.	Work during 1902.	Work previously reported.	Total.	
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Acres.*
Arizona	95	400	495	316,800
California	753	1,401	2,154	1,378,560
Colorado	150		150	96,000
Connecticut		245	245	156,800
Georgia	571		571	365,440
Idaho	399		399	255,360
Illinois	1,359		1,359	869,760
Iowa	432		432	276,480
Kansas	461		461	295,040
Kentucky	330		330	211,200
Louisiana	202		202	129,280
Maryland	418	1,762	2,180	1,395,200
Massachusetts		155	155	99,200
Michigan	828		828	529,920
Mississippi	666		666	426,240
Missouri	168		168	107,520
Montana	105		105	67,200
New Jersey	908		908	581,120
New Mexico		100	100	64,000
New York	490		490	313,600
North Carolina	1,625	1,800	3,425	2,192,000
Ohio	500	480	980	627,200
Pennsylvania	519	420	939	600,960
Porto Rico	330		330	211,200
South Carolina	686		686	439,040
Tennessee	547		547	350,080
Texas	495		495	316,800
Utah		768	768	491,520
Virginia	1,354	250	1,604	1,026,560
Washington	150	301	451	288,640
Total	14,541	8,082	22,623	14,478,720

The following table shows the area surveyed and mapped and the cost of the work during the fiscal year ended June 30, 1902:

Areas surveyed and mapped and cost of the field work during fiscal year ended June 30, 1902.[a]

State or Territory.	District.	Area surveyed.	Cost per square mile.	Total cost.
		Sq. miles.	*Dollars.*	*Dollars.*
Arizona	Yuma area	95	4.61	437.95
California	Imperial area	169	3.17	535.73
Do	Salinas Valley	344	3.42	1,176.48
Do	Ventura area	240	3.77	904.80
Colorado	Rockyford area	150	4.73	709.50
Georgia	Cobb County	346	1.44	498.24
Do	Covington area	225	.71	159.75
Idaho	Boise area	399	1.81	722.19
Illinois	Clinton County	494	.88	[b]434.72
Do	St. Clair County	215	1.15	[b]247.25
Do	Tazewell County	650	1.39	[b]903.50
Iowa	Dubuque area	432	.94	406.08
Kansas	Wichita area	461	1.94	894.34
Kentucky	Union County	330	2.20	726.00
Louisiana	Lake Charles area	202	3.71	749.42
Maryland	Harford County	418	1.48	618.64
Michigan	Allegan County	828	1.44	1,192.32
Mississippi	Yazoo area	656	2.24	1,489.96
Missouri	Howell County	168	1.14	191.52
Montana	Billings area	105	4.96	520.80
New Jersey	Salem area	493	1.42	700.06
Do	Trenton area	415	2.23	925.45
New York	Westfield area	260	2.89	751.40
Do	Elmira area	230	2.03	466.90
North Carolina	Alamance County	365	1.32	[c]482.80
Do	Carey area	63	3.11	[c]195.93
Do	Craven area	697	.96	[c]669.12
Do	Hickory area	500	1.01	[c]505.00
Ohio	Columbus area	338	1.34	452.92
Do	Toledo area	162	.95	153.90
Pennsylvania	Lebanon area	[d]519	1.48	768.12
Porto Rico	Arecibo to Ponce	330	5.02	[e]1,655.55
South Carolina	Abbeville area	686	1.01	692.86
Tennessee	Montgomery County	547	1.68	918.96
Texas	Alvin area	280	2.45	686.00
Do	Willis area	215	2.70	580.50
Virginia	Bedford area	[d]382	2.11	806.02
Do	Harrisonburg area	542	1.44	780.48
Do	Prince Edward area	430	1.32	567.60
Washington	Walla Walla area	150	1.82	273.00
		14,541	1.83	26,551.76

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[a] This includes the salaries of the men while in the area and their subsistence expenses, but not the cost of transportation to and from the area.
[b] Of these amounts, $624.95 was spent by the Illinois experiment station.
[c] Of these amounts, $914.20 was paid by North Carolina department of agriculture.
[d] The portions of these areas surveyed in the previous fiscal year were given in the last report.
[e] Of this amount, $300 was paid by the Porto Rico experiment station.

RECAPITULATION.

Cost of field work		$26,551.76
Supplies		858.84
Railroad transportation		2,766.28
Preparation of reports		12,870.17
Total cost of soil survey		43,047.05
Paid by State organizations		1,839.15
Paid by Department of Agriculture		41,207.90
Area surveyed	square miles	14,541
Cost of work in field	per square mile	$1.83
Preparation of reports	do	.88
Transportation and supplies	do	.25
Average cost	do	2.96
Average cost to Department of Agriculture	do	2.81

It will be noticed that the cost of the work per square mile varies from 71 cents in the Covington area, Georgia, to $5.02 for the work in Porto Rico. The average cost has been $1.83 per square mile, as against $2 per square mile during the preceding fiscal year. The area covered is over two and one-half times as large, and the work has cost 17 cents per square mile less than last year. The variation in the cost per square mile is due in part to the character of the country, the condition of the roads and of the weather, the complexity of the soils, the presence and character of alkali in the Western areas, and the accuracy of the base maps used. The average cost to the Department of Agriculture of the work complete, including supplies and railroad transportation, the preparation of reports, and the salaries of the men during the three winter months, when the field work has practically to be suspended, has been $2.81 per square mile, as against $3.26 per square mile last year, a saving of 45 cents per square mile. This saving is due not only to the greater efficiency of the field parties by reason of their better training, but also to the longer average length of the field season for each party, which has been accomplished by moving the parties from place to place as the season advances. It has been found possible to keep some of the parties out during the winter in Arizona and southern California, and to shift parties working in the Northern States during the summer months to the Southern States during the fall. In this way the average length of the field season has been something over nine months per party, and it is believed that this can be considerably increased, although it is advisable to have each party spend some time at headquarters, not only for the final revision of their reports and maps, but to get acquainted with the office and laboratory work and to keep in close touch with the objects and purpose of the soil survey.

THE FIELD FORCE.

The organization of the field force has been carried to a very high state of efficiency. Administratively the very greatest of care and attention to details is given, and the low cost per square mile shown in the preceding statements is due in a large measure to the judicious and economical management of the force. The salaries of the soil experts employed by the Bureau are low as compared with those paid in other branches of scientific work. The average expense of a party of two men in the field for subsistence and the hire of a team averages about $120 per month, or $1,080 for the field season of nine months. The parties are equipped with the most modern instruments for the classification and survey of soils, and it has been possible to furnish them with such explicit instructions as to the character of their work, the subjects they are to investigate, and the subjects which are to be discussed in their report upon the area that they know exactly what is to be done on entering a given area and can proceed with their work with the minimum of time for preliminary investigations or reconnoissances. They are required to report to the central office at least once each week, noting the area surveyed, the new soil types established, and the character of their work, and to send in from time to time sections of their map for criticism and suggestion as the work proceeds. It is required that each party shall complete the map in all details and write up the report in final shape before leaving the area. These reports are then typewritten, and a copy returned to the field party for correction or for additions or changes. The work of each party is thoroughly inspected, so far as this has been possible, in order to correlate the new soil types with those already established, and to confer with the men as to suggestions which can be safely made of new methods of cultivation or of new industries which may be established. As the work of the soil survey assumes greater proportions this inspection work becomes more and more necessary and more valuable, and it is advisable that a regular inspection force should be established for the several districts into which the country may be divided.

The scale upon which the soil maps are published enables tracts as small as 10 acres to be represented, and while there must always be some variation allowed in each type, as it would be confusing to show too much detail on the maps, still, where a type is represented by even a small tract of 8 or 10 acres, it is shown upon the soil map, so that landowners may rely upon an accurate classification of their soils according to the types established.

The reports describe in all necessary detail the characteristics of the soils and their important variations; the history of the settlement and agricultural development of the area; the climate, physiography, and geology; the agricultural methods in use and the agricultural conditions in the area, such as the tenure and size of the farms, the efficiency of labor, the principal products, and transportation and market facilities, together with such special problems as may be encountered, such as hardpan, acidity, irrigation, seepage waters and drainage, alkali, and the reclamation of swamp or worn-out lands or alkali soils, as these all have their bearing upon the commercial use and value of the soils.

RELATION OF THE SOIL SURVEY WORK TO THE EXPERIMENT STATIONS.

With the increasing interest in the soil investigations and the economic value which the results have shown in a number of cases, the experiment stations are taking a lively interest in this work, and it seems proper to mention the true relation which should be established between them and the Department in the further prosecution of the work. It seems advisable that the management of the soil survey should be vested in the Department of Agriculture. This insures continuity in the work and uniform classification of soils; also the benefit of experience in other localities in advising as to the commercial possibilities and value of the introduction of new methods of culture and of new crops and industries. It is advisable that the experiment stations and other State institutions should cooperate in this work to the extent of furnishing assistants or financial aid, as this insures an intimate knowledge of the conditions of the area to the State organization, as well as a larger amount of work within the borders of the

State. In many cases, if such financial assistance be given, one or more parties can be assigned for continuous work in a State where, if the expenses were all borne by the Bureau of Soils, a party could be assigned for only a portion of the season. Various State organizations have contributed $1,839.15 toward the field expenses of the soil survey during the past year.

These soil surveys are in the nature of a general reconnoissance of the area. They show the conditions which prevail, and the maps show the character and distribution of the soils. This is, however, merely a basis for further work, and it is necessary in many cases that the information thus furnished and the suggestions which are made should be followed by further investigations and practical demonstrations of the efficiency and commercial value of the suggestions in order to insure their successful adoption by the residents of the area. Farmers are proverbially ultraconservative as to their methods, and are usually, and often justifiably, very unwilling to accept advice unless it can be shown that improvement will surely follow. Such demonstration work can, in most cases, be better accomplished by the stations than by the Department of Agriculture, for the station forces have a more intimate knowledge of the conditions and of the people, and are, as a rule, in closer touch with the people than is the Department, and with these reports and maps they have the basis for further work in the improvement of the agricultural conditions of the area, upon which they can expend their full energy and all the resources at their command. If the soil-survey work is not followed up on these practical lines, much of the efficiency and value of the work will surely be lost.

As pointed out in my last report, the experience of the men engaged in this work is likely to be invaluable, not only to them, but to the country as well. Spending, as they do, from three to nine months in an area, making a critical study of the soils, crops, methods of cultivation, and market and transportation facilities, and bringing together this experience from all sections, the men have unusual opportunities for securing a wide knowledge of the agricultural industry of the country and its resources. This is training up a class of men fitted to observe and appreciate resources and advantages that should be of great value in the further development of the agricultural interests of the United States as the country becomes more thickly settled and the strife for commercial supremacy becomes greater. As these men become riper in experience and judgment and have a fuller knowledge of the agriculture of the country, they will doubtless be called to positions of trust and responsibility in State organizations and in commercial enterprises in which their experience and ability will be invaluable. This is and should be one of the important functions of the Department, and the influence of the Department will be felt more and more throughout the country as these men are called to such positions.

PAST AND PROPOSED WORK OF THE BUREAU OF SOILS.

The statements following show the results that have been accomplished during the past year and the work that is proposed during the present and the next fiscal year in each of the States. This is of course subject to change as to details as the time approaches for the actual prosecution of the work. It is given as the basis for the continuation and extension of the work.

ALABAMA.

No work has been done in this State during the past fiscal year, but it is proposed this fall to make a soil survey of Perry County, which lies partly in the black calcareous prairie belt and partly in the sand region. Two parties will be assigned to this area in October, with the expectation that the whole of the county can be surveyed during the present field season. On the completion of this work both parties will be transferred to Mobile County to make a soil survey of that area, particularly in the interest of the truck growers, and to investigate the adaptation of the soils to tobacco. After this it is contemplated to make a soil survey in Marshall County in the interest of the fruit and tobacco growers, and to survey Lauderdale County, if possible. In all, it would be advisable to spend nine months in Alabama during the next field season.

ARIZONA.

During the past field season a soil survey was made of the area below Yuma, where the waters of the Colorado River are taken out for irrigation. The whole area covers about 95 square miles, although only a portion of it is at present under ditch. A considerable part of this area is subject to overflow during flood times in the Colorado River, and schemes have been proposed for dikes and levees to prevent this overflow, which, if carried out, will add a considerable area of valuable land to the irrigated district. This tract, with its tropical climate and fertile soils, has been compared to the delta of the Nile, and it is the intention of the Department, through its soil survey and through the work of the Bureau of Plant Industry, to see if crops equally as valuable as those cultivated along the Nile and adapted to this tropical climate can not be introduced.

This party was in charge of Mr. J. Garnett Holmes, who has had considerable experience in soil survey work in other parts of Arizona and in southern California.

It is believed that the information obtained in this work will be the basis of most valuable economic development in the introduction of crops from Algeria and Egypt. There is quite a variety of soils of different character in this area, and while there is considerable trouble with alkali it is believed that this problem can be easily controlled and that the locality will develop into one of the important irrigated districts of the West.

It seems advisable to spend three months in a soil survey of the upper Gila Valley around Solomonville during the next field season.

ARKANSAS.

No soil surveys have been made in this State during the past fiscal year, but a party is at present in the State, making a survey around Stuttgart. It is impossible at this time to make any statement as to the economic results of this work.

CALIFORNIA.

Soil surveys have been carried on in three areas during the fiscal year, namely, around Imperial in the Colorado Desert, in the Salinas Valley, and in the Ventura area.

The work in the Salinas Valley was undertaken particularly in the interest of the sugar-beet growers. This was formerly a great wheat area, but in recent years the yield of wheat has fallen almost below the point of profitable production and barley has taken its place to a considerable extent. The rainfall, however, is so variable that crops are uncertain without irrigation, and irrigation systems are now being planned, particularly for the sugar-beet industry, which has developed to large proportions.

This party was in charge of Mr. Macy H. Lapham, and the area surveyed covered 344 square miles. Eleven different types of soils were recognized and their relation to the various crops determined. The relation of these soils to crops had been recognized to a certain extent, but the orderly classification of the soils can not fail to be of value in the future development of the agriculture of the area, especially as the industry is at present changing and developing along new lines.

All of the soils capable of cultivation in Ventura County were surveyed by a party under the charge of Mr. Holmes, the area aggregating 240 square miles. There are several valleys where irrigation is practiced, the most extensive being the valley of the Santa Clara River. Over a large part of the area, however, crops are grown without irrigation, the principal crops being lima beans, sugar beets, and barley.

The soils of the upper part of the Santa Clara Valley are generally well drained and free from alkali. Extensive areas of the delta lands, including some of the most fertile soils of the county, are deficient in drainage, and the alkali problem is becoming more and more serious. As a result of the survey, and from experiments that have been made at the suggestion of the Bureau, it is evident that the alkali problem can be economically and efficiently controlled. Thirteen types of soils were recognized in this area and their relation to crops reported upon.

From the results attained in the irrigation of the area below Yuma, and from the exceedingly arid climate, it was believed that the Colorado Desert afforded exceptional facilities for the introduction of certain tropical plants, as well as for Egyptian cotton and other products successfully grown in Egypt and on the Algerian Desert. In furtherance of this idea, a company was organized under the laws of Mexico to construct a canal through Mexican territory and deliver water from the Colorado River to a point near Calexico, on the border line between this country and Mexico, to a company chartered under the laws of the United States to distribute the water to settlers in the Colorado Desert. The land was taken up under the homestead and desert-land laws and water rights purchased from this company for the irrigation of the lands. It was realized that it was very desirable, as this enterprise was starting, to make a soil survey in order to classify the soils and determine their alkali content and their relation to crops. Accordingly, Messrs. Means and Holmes were assigned to this work, and an area of 169 square miles was surveyed around Calexico and Imperial.

This country lies at or somewhat below sea level, the Salton Sink, the lowest portion of the desert, being about 270 feet below sea level. Five distinct types of soil were recognized in this area, ranging from a loose, incoherent dunesand to a very impervious clay, and including a sand, a sandy loam, and a loam. The area is everywhere underlain with a stiff, impervious clay containing alkali. The Imperial clay is difficult to cultivate, and water penetrates it very slowly. Large areas of alkali lands were encountered, and it is estimated that about 54 per cent of the area has more than 0.4 per cent alkali as an average for 6 feet in depth. There are serious problems, therefore, to be encountered in the successful development of agriculture in the area. It is believed that about 50 per cent of the area can at present be cultivated in nearly all crops adapted to the locality, while a considerable portion of the remainder may be reclaimed by drainage, or can be used for alkali-resistant crops.

The importance and necessity of having this knowledge of the soil conditions has been recognized, and very urgent requests have been received for an extension of the soil-survey work to embrace practically all of the lands in the Colorado Desert which can be irrigated, as a basis for the intelligent cultivation of this area, and to insure, as far as possible, the successful settlement of the country. Recognizing the importance of this work, it is proposed to combine a number of our field parties and place them in the area during the coming fall and winter to make a soil survey of about 1,500 square miles of the Colorado Desert, so that settlers may know the actual character of the soils which they purchase, and that industries can be established on the soils best adapted to them.

In addition to this work it is proposed to extend the soil survey to the Santa Clara Valley in the interest of sugar-beet, grain, and stock production, and to take up the San Bernardino Valley in southern California, which is the last of the great fruit areas in southern California that remains to be surveyed. It is believed that very valuable results will be attained by the soil survey when it is extended to the sugar-beet area around Chino and the fruit areas of Pomona, Riverside, San Bernardino, and neighboring towns.

In all it appears desirable to spend twenty-one months, on the basis of one party, in the State of California during the next field season, and it is believed that the importance of the areas to be investigated fully justifies the time and attention to be given to the work.

COLORADO.

During the present field season a soil survey is being made, under the charge of Mr. Macy H. Lapham, of the irrigable lands of the Arkansas Valley between Rockyford and the Kansas State line. There will be nearly 1,000 square miles of intricate soil mapping, with alkali problems to be worked out, but it is believed that by concentrating some of the northern parties in this area during the fall the whole area can be surveyed. This work is undertaken principally in the interest of the sugar-beet growers and of the melon and truck growers. Not only is it desirable to understand better the relation of the soils to crops, but with the extension of irrigation systems the natural drainage is found to be deficient and alkali is rising and threatening trouble and losses. The work has progressed far enough to indicate that the alkali problem can be economically and efficiently controlled, and it is believed that the classification of the soils will give a basis for the most profitable development of the sugar-beet and truck interests of the area.

It appears desirable to spend about six months during the next field season in a survey of the San Luis Valley, where the alkali problem is becoming far more serious even than in the Arkansas Valley.

CONNECTICUT.

No extension of the soil survey has been made in the Connecticut Valley since 1899, but with the extension of the profitable industry of producing the shade-grown Sumatra tobacco there is a very strong demand now that the survey should be extended to include many smaller valleys on either side of the area surveyed in 1899, and it is proposed to spend about three months in the State during the next field season, to give a basis for the extension of the tobacco industry on either side of the main valley.

DELAWARE.

No surveys have been made as yet in Delaware, and none is contemplated during the present year. There is, however, a demand for a soil survey to extend over the entire State, and it seems desirable to spend three months in the State during the next fiscal year in such work.

FLORIDA.

No surveys have been made in this State up to the present time, but it is proposed, if suitable arrangements can be made for a base map, to make a soil survey in Gadsden County in the interest of the tobacco growers.

GEORGIA.

During the past fiscal year two areas were surveyed in Georgia, including Cobb County and an area around Covington, the former being under the charge of Mr. R. T. Avon Burke and the latter of Mr. Herbert W. Marean.

It was hoped that the survey in Cobb County would show the possibilities of fruit raising, but it is believed that the prospects for this industry are not so favorable in this locality as they are farther north, and it is therefore proposed to extend the survey to include the northern half of the Ellijay sheet of the United States Geological Survey to include portions of Union, Gilmer, and Fannin counties in the interest of the fruit growers and as an extension of the survey in the mountain areas in Virginia and North Carolina. It is intended to give about six months to this work during the next field season, and it is also proposed to survey an area in Decatur County in the interest of the tobacco growers.

HAWAII.

No soil survey has been made in this Territory as yet, but there have been strong demands for the work, and a recommendation will be made for needed legislation to permit the Department to extend its soil survey work to that Territory at an early date.

IDAHO.

A soil survey party, under the direction of Mr. C. A. Jensen, has completed a survey of the Boise area, extending from Boise City to a point some distance west of Caldwell and including the principal irrigated lands of that section. Serious problems were encountered in this area in the occurrence of hardpan in the soils, and there were other soil problems upon which advice was given which it is believed will be of material economic value in the agricultural development of the area, which is assuming considerable importance.

A party, in charge of Mr. Louis Mesmer, has been assigned to survey the area between Lewiston and Moscow. The wheat yields in this area have declined, and the people are anxious to introduce forage crops, and the soil survey work is to be used as a basis for the consideration of this problem.

Representations have been made to the Department which make it appear advisable to spend about six months in the next field season in the survey of the irrigated lands of the Blackfoot area.

ILLINOIS.

Through cooperation with the Illinois experiment station the Bureau was enabled to put two parties in the field during the early part of the present field season, and at the close of the fiscal year had made a soil survey of Tazewell and Clinton counties, under the direction of Mr. Jay A. Bonsteel, and a portion of St. Clair County, under the direction of Mr. George N. Coffey. During the remainder of the present field season it is proposed to finish St. Clair and Clay counties, if time permits. So far as this work has been examined, particularly the finished maps of Tazewell and Clinton counties, it is believed that the results will be of material benefit and value to the farmers. Thirteen soil types were recognized in Tazewell County and seven in Clinton County and their relation to crops reported upon.

A copy of the soil map and report on the Tazewell area has been sent to one of the most intelligent and progressive landowners, with the request that the work be critically examined and freely criticised, so that we may get advice in advance of publication as to the practical utility and usefulness of the work and suggestions as to other lines that could be profitably developed.

So far as the Bureau is at present informed this work has aroused a great deal of interest, and it is believed that it will be of value to the people. Requests have been made for upward of 25,000 copies of each of these reports, with accompanying maps, to supply the local demand which is likely to arise. So much interest has been taken in this survey that urgent requests have been made by the Illinois experiment station that the work shall be continued in the State, and it is proposed to assign a party to the State for the entire field season of nine months during the coming year. It is understood that the station will continue its cooperation, and possibly arrangements can be made for more than one party, so that the work may progress rapidly.

One of the most serious problems encountered in the soil survey, particularly in Clinton County, is in the hardpan, or the compact nature of the underlying clay subsoil, in some of the soil types. This not only renders cultivation difficult, but makes crops uncertain under certain climatic conditions, and an investigation of the cause of this and a possible remedy is now engaging the attention of the laboratories of the Bureau.

INDIANA.

No work was carried on in this State during the past fiscal year, but a party is at present engaged in making a soil survey of Posey County. This is in charge of Mr. Marean, and the whole area of the county is to be surveyed. This is particularly in the interest of the truck growers, as large quantities of watermelons and other truck crops are produced on some of the sandy soils of the area.

While there has been some demand for the extension of this work to include the whole area of the State, the plans at present contemplate a survey of only three months' duration in Boone County during the next field season.

IOWA.

During the past fiscal year a soil survey has been made around Dubuque, under the charge of Mr. E. O. Fippin. Eight soil types have been recognized and their relations to crops reported upon.

Rather strong demands have come for the continuation and extension of this work to include the entire State, but it is proposed to spend but six months during the next field season in surveying a part of Cerro Gordo and Story counties in the interest of sugar-beet production, as well as of general farming, stock raising, and dairying.

KANSAS.

During the past field season 461 square miles have been surveyed around Wichita. It was expected that this would be a very uniform area, but nine soil types were encountered, each with distinct properties and adapted more or less to different crops or requiring different methods of cultivation. The possibilities are shown of some degree of specialization of crops and the introduction of fruit interests to take the place of the almost universal crops of wheat and corn, which it is believed will be of value in the further development of the agricultural interests of the area. This work has been in charge of Mr. J. E. Lapham.

It seems desirable to spend about six months in the survey of a portion of the Parsons sheet of the Geological Survey, in the north-central part of the State, in what may be considered the beginning of the semiarid portion of the West.

KENTUCKY.

During the past fiscal year a survey was made of Union County, which has an area of about 330 square miles, under the charge of Mr. Marean. Eight types of soil were recognized, and while apparently the soils are quite uniform in texture and natural fertility, the possibilities of introducing new industries and better methods of cultivation were clearly indicated. At present the area is given up almost exclusively to wheat culture, but there are good opportunities for greater diversification through improvements in the management of soils, the rotation of crops, and in growing products new to the area.

Demands for soil-survey work in Kentucky have been quite strong, and it seems desirable to assign a party to that State for nine months during the next field season, the surveys to include Henderson, Christian, and Scott counties. This work will be mainly in the interest of the tobacco growers, stock raisers, and general agricultural interests.

LOUISIANA.

A soil survey was made during the last fiscal year by Mr. W. H. Heileman in the Lake Charles area in the interest of the rice growers, an area of 202 square miles having been covered. Six types of soil were recognized in what was supposed to be a uniform area, and it was found that the relation of these soils to the yield of rice was quite marked, and the desirability of extending the survey to other rice districts was clearly recognized. Moreover, under the present system of exclusive rice culture, not even sufficient food for the stock is produced, while meat and vegetables for the support of the people are imported in large part from other States. There is no reason for this so far as the soils or climatic conditions are concerned, and it is pointed out that a proper diversity of interests would materially add to the welfare of the community.

It seems desirable to spend three months during the next field season in Arcadia Parish in the interest particularly of the rice, sugar, and tobacco producers.

MARYLAND.

Very strong demands have come for the continuation of the surveys in Maryland to include the whole of the State, and particularly of

Worcester, Somerset, and Baltimore counties, and it is proposed to assign a party there for six months during the next field season.

During the past fiscal year Harford County, covering an area of 418 square miles, has been surveyed by a party under the charge of Mr. W. G. Smith. There is no place where the survey has been carried on where more interest has been manifested and more use has been made of the work than in this State. Possibilities have been shown, particularly in Prince George, St. Mary, and Calvert counties, of the specialization of crops in the line of fruit growing, trucking, and general farming and dairying, which would very materially benefit the people and add greatly to the prosperity of the community.

While much work has already been done in this State, it is believed that the intelligent interest and appreciation shown in the results of the work justify the Department in pushing the surveys and giving the people the information they seem to need, and which they appear ready to benefit by in the practical extension of their agricultural interests and in developing the prosperity of the State.

MASSACHUSETTS.

No work has been done in this State since 1899, and the establishment of the profitable Sumatra tobacco culture has aroused a decided demand for the extension of the survey of 1899 in the Connecticut Valley northward to the State line and on either side of the area which has already been surveyed. It is proposed to spend three months during the next field season in the extension of this work, in the interest particularly of the tobacco growers.

MICHIGAN.

During the past fiscal year Allegan County, covering an area of 828 square miles, has been surveyed under the direction of Mr. E. O. Fippin. This work was undertaken particularly in the interest of the fruit growers along the lake shore and of the sugar-beet and general agricultural interests. This appears to be one of the most valuable pieces of work the Bureau has done, and it is believed that the results, which form a part of the report of the field operations for 1901, will be of very great value to the people in the extension of their present industries, the improvement of methods of cultivation, and the development of new crops, which it is believed can successfully be introduced. The experience of the people of this section will also prove of value to other communities, and the lessons taught by the soil survey will, it is believed, have value outside of the area.

No work is contemplated for this State during the next field season, but strong demands have come for an extension of the survey, and it is believed that it should be resumed at the earliest practicable time, particularly in the interest of the sugar-beet and fruit growers.

MINNESOTA.

No work has been done in the State, but strong demands have come for the extension of the soil survey, and it seems desirable to assign a party there for six months during the coming field season, the first area to be surveyed being probably Lyon County.

MISSISSIPPI.

During the past fiscal year the Bureau has mapped an area of 656 square miles around Yazoo City, the work being in charge of Mr. Jay A. Bonsteel.

About one-third of the area is in the uplands and two-thirds in the Yazoo and Mississippi Delta. The upland soil is a typical loess, and it has been suggested, as a result of the survey, that alfalfa can be produced on it as a basis for stock raising. In its present condition it is little esteemed as a cotton soil.

It was supposed that the delta would present a very uniform soil condition, but four soil types were recognized, each with very distinct agricultural values. The Yazoo clay is the most productive cotton soil, yielding from 1⅓ to 1⅔ bales per acre, and even more under the best methods of cultivation. This, however, covers only about 17 per cent of the delta. The Yazoo loam, covering about 6 per cent of the delta, yields from three-fourths to 1 bale of cotton per acre. The Yazoo sandy loam, covering 9 per cent of the delta, produces about three-fourths of a bale to the acre, while the Sharkey clay, covering 68 per cent of the delta, is not cultivated on account of the annual overflow. The flood waters leave the land about the 1st of June, but although the land is subsequently dry it is then too late for crops to be put in.

It has been pointed out, as a result of this soil survey, that the Yazoo sandy loam is a typical early truck soil, and that, with the prevailing climatic conditions, potatoes or other truck crops would prove a remarkably profitable industry on this soil.

The Sharkey clay is a wonderfully productive soil, and it appears from the investigations that have been made that the engineering problem of protecting it against the annual floods would not be very difficult, nor expensive when the value of the soil so reclaimed is considered. It is believed that these three suggestions, if followed by the people, will well repay the money expended in the survey.

It is proposed to continue and extend this work to include a larger area of the delta lands and possibly to take up one other area in the State, devoting in all about six months in the next field season to the work.

MISSOURI.

During the latter part of the past fiscal year Mr. Fippin was assigned to survey Howell County, in the fruit area of the Ozark region. It is probable that the whole area of this county will be surveyed during the present field season. It has been found that the soils are remarkably uniform and that the fruit interests can be extensively developed, but it is advisable that the methods be improved to attain the highest commercial success.

The demand for the continuation and extension of this work in Missouri has been so great that it seems desirable to assign a party there for nine months for the survey of Shelby, Saline, and Webster counties during the next field season.

MONTANA.

During the past fiscal year the Billings area, comprising about 105 square miles, has been surveyed under the direction of Mr. C. A. Jensen. Considerable trouble and loss has resulted from the rise of alkali in this area, and the survey was planned with particular reference to determining the possibility of preventing this trouble and reclaiming the land already damaged. It is considered quite feasible to accomplish this object, and it is probable that a demonstration will be made of the efficiency of proper drainage in preventing the rise of alkali and in reclaiming the alkali soils of this locality.

It would seem desirable to assign a party to this State for six months in the next field season to make surveys in the Gallatin Valley and in the Milk River Valley around Glasgow.

NEBRASKA.

No work has heretofore been done in this State, but it is proposed to assign a party for nine months of the next field season to make soil surveys of the Grand Island and Holdrege areas in the interest particularly of the sugar-beet industry.

NEW JERSEY.

During the fiscal year just passed a survey of the Salem area, comprising 493 square miles, was completed under the direction of Mr. Bonsteel, and a survey of the Trenton area, under the charge of Mr. Burke, has been started and will be completed during the present field season.

The Salem area lies wholly within the Coastal Plain region and has eleven different types of soil. These are adapted to various truck crops, fruit interests, and general farming. The people have already recognized the relation of the soils to crops and have adapted their industries to the various soil areas. The success has been so remarkable that the lesson may well be carried to other localities along the Atlantic coast where similar soils prevail.

The Trenton area lies partly in the Coastal Plain and partly in the Piedmont Plateau, and gives even a wider range of soils. This area is particularly adapted to specialization of crops and the building up of widely different agricultural interests.

The interest in this work justifies its continuation, and it seems desirable to spend six months during the next field season in the survey of the Monmouth Shore area, east of and immediately adjoining the Trenton area.

NEW YORK.

During the past fiscal year a soil survey was made of the Westfield area under the direction of Mr. Burke, and of the Elmira or "Big Flats" area under the direction of Mr. Mesmer.

The Chautauqua grape belt, extending for 30 miles along the Lake Erie shore, is within the first-named area. The old beaches, where the grape industry was first developed, have been outlined upon the map, and the Dunkirk clay, upon which the industry has since been developed, is also located, as well as several other foreland and upland soils adapted to general farming and dairying.

The survey of the Elmira area was undertaken particularly in the interest of the tobacco growers, and more especially to see if the cultivation of Sumatra tobacco could be extended there, and to form a basis for other tobacco investigations for the improvement of their present crops. The results indicate that the Sumatra tobacco can not successfully be produced within the area surveyed, except in one small area of not over 10 or 15 acres, where it might be grown. An experiment is in progress to determine this point, although this is not under the control of the Department. The results of the survey point to the need of further investigations of these soils, which under the present methods of cultivation require large annual applications of stable manure to produce satisfactory yields cf the crops of the locality. There is an opportunity here for the work of the new division of soil management, which would probably yield results of value to the people.

During the present field season the survey has been extended to the Lyons area in the interest particularly of the sugar-beet growers. It is proposed during the coming field season to detail a party for nine months to make a soil survey of the whole of Long Island. This is particularly in the interest of the truck growers, and it is believed that the results will be of considerable interest and value.

NORTH CAROLINA.

During the past fiscal year a survey has been made of the Alamance County, Cary, and Craven areas under the direction of Mr. Coffey and of the area around Hickory under the charge of Mr. Caine.

Alamance County is in the Piedmont Plateau, and the work was undertaken in the interest of the cotton growers and general farming. Formerly this was an important bright-tobacco section, but the growth of this industry in the eastern part of the State has been the cause of a decline in tobacco production in the area, and the soils formerly adapted to this special industry have depreciated considerably in value. Various suggestions of a practical nature in the line of improved methods of cultivation and the introduction of new crops and new industries have been made as a result of the soil survey.

The work in the Craven area was carried on particularly in the interest of the truck growers and in order to outline the truck soils in this area, which is not as yet very thickly settled.

The work in the Hickory area was in the interest of general farming and, in the mountainous portion, of fruit growing. It is proposed to extend this work during the present field season to the Mount Mitchell area in the interest of the fruit growers.

There is no more interesting development at the present time in the Atlantic coast States than that of the fruit interests in the mountains of Virginia, North Carolina, Georgia, and Alabama. From the work so far done in these States it is clearly apparent that the soil has an important bearing on the different fruit crops, and the apple and peach soils can be identified and outlined as a basis for the intelligent development of these industries. Not only are certain soils adapted to apples, but certain varieties of apples do better on some soils than on others, and the same is probably true of other fruits.

The North Carolina department of agriculture has cooperated very cordially and very helpfully in this work, and it appears desirable to continue this cooperation, assigning a party there for nine months during the coming field season to extend the soil survey.

NORTH DAKOTA.

Very strong demands have come from this State for the extension of the soil survey to include most of the arable portion of the State. It has been impossible until recently to start the work there, but a party has just been assigned to the Grand Forks area, in the Red River Valley, under the direction of Mr. Jensen, who has had wide experience in similar areas in Utah and Montana.

Considerable quantities of alkali are encountered, but generally at a sufficient depth below the surface to enable the annual crops to be produced. The surface foot is usually free from alkali, and as there is no irrigation, and little chance for irrigation, it is believed that there is little danger of the alkali coming to the surface and spreading. It seems a risky thing, however, to have the valuable crops of the locality growing over and so close to these alkali salts, and the possibility of the rise of this alkali should be fully investigated. If it were in an area where water was available for irrigation, it could safely be predicted that the land would quickly be injured by the rise of alkali, but with no opportunity for irrigation the chances are that conditions may not become more serious than at present. This is a question, however, that these investigations will have to solve. The work is being carried on in cooperation with the State geologist.

It seems desirable to assign a party to this State for six months' work during the next field season.

OHIO.

During the past fiscal year work has been started in the Columbus area and in the Toledo area, and it is believed these will both be completed by the end of the present field season. The surveys are being made under the direction of Mr. W. G. Smith.

The Columbus area is devoted to general farming. While there is a certain uniformity in the soils, one of the principal soils is preeminently a wheat land and another chiefly a corn land, the character of the soils showing very strongly their peculiar agricultural values in the crops produced and in the success of these crops.

It is proposed to assign a party to this State during the next field season to survey a part of Ashtabula County in the interest of the fruit and tobacco growers.

OREGON.

No surveys have been made in this State, but it is proposed to assign a party there for six months during the next field season to survey an area around Salem, in the Willamette Valley.

PENNSYLVANIA.

During the past fiscal year a survey of the Lebanon area, in the interest of tobacco growers and general farming, was completed under the direction of Mr. Smith. The interest taken in the survey around Lancaster leads me to believe that the results of this work will be found of interest and practical value in the still higher development of the agricultural conditions of the locality.

It seems desirable to assign a party for three months during the next field season to make a soil survey of Clinton County, particularly in the interest of the tobacco growers.

PORTO RICO.

During the past fiscal year an area of 330 square miles was surveyed in a strip about 10 miles wide, extending from Arecibo to Ponce, the work being in charge of Messrs. Dorsey and Mesmer. Twenty-two types of soils were recognized, all of them markedly different from the soils encountered in the United States. Much of the country is rugged, broken, and mountainous, and as there were no available maps, the base map had to be made as the soil survey progressed. Many of these soils are not well adapted to agriculture, but the report deals fully with the conditions as they were actually seen, and it is believed that it will form a basis for a more intelligent development of the agriculture of the island.

It is deemed advisable that this survey should be extended to include the whole area of the island, of which about one-tenth is included in the area already surveyed, but under a change made in the wording of the appropriation bill it will be impossible for the Bureau of Soils to continue this work. It will be recommended that such changes be made in the next appropriation act as will enable the Department to resume operations in Porto Rico. I know of no more valuable work the Department can do than to thus investigate the actual conditions in these island possessions, and the extension of the soil survey to them should give a basis for the best and most economical development of their agricultural resources at a time when so many people are looking to these islands for investments and when the people of the islands themselves need all the help that can be given them.

SOUTH CAROLINA.

During the past fiscal year an area of 686 square miles has been surveyed around Abbeville, and on the completion of this work the party, in charge of Mr. Taylor, will make a survey of Darlington County, particularly in the interest of the bright-tobacco growers and truck growers.

It is proposed to detail a party for nine months during the coming field season to survey an area in Spartanburg, Pickens, and Orangeburg counties, particularly in the interest of the cotton, fruit, and bright-tobacco growers.

SOUTH DAKOTA.

No surveys have been carried on in this State, nor are any contemplated for the present field season. It seems desirable, however, to assign a party for a period of three months during the next field season to start a survey in Brookings County.

TENNESSEE.

During the past fiscal year a survey in the interest of the tobacco growers was made of Montgomery County, embracing an area of 547 square miles, under the direction of Mr. J. E. Lapham. Among the important results of this survey has been the suggestion that one type of soil which is at present of little agricultural value and which covers a considerable area, is adapted to fruit growing, and it is believed that this interest could be introduced with profit to the community. It was hoped that the survey would be the basis of an investigation of the possibilities of improving the tobacco interests, but the appropriation for the Bureau was not sufficient to enable this to be done.

It is proposed to extend the soil survey to Greene, Cumberland, and Davidson counties, assigning a party to this work for a period of about nine months during the coming field season.

TEXAS.

During the past field season the Willis area of 215 square miles has been surveyed in the interest of the tobacco growers, and a party of tobacco experts has been placed there to investigate the possibility of producing a more desirable filler tobacco.

The Alvin area was also started under the direction of Mr. Bennett, and this and the Brazoria area will probably be completed during the present field season. This is particularly in the interest of the fruit growers around Alvin and of the sugar interests around Brazoria.

It is also proposed to survey an area during the present field season around Vernon, in the Panhandle of Texas, in the interest particularly of the wheat growers and with the view that the results may be useful in the introduction of macaroni wheat.

Representations have been made to the Department which make it appear advisable to assign a party to this State for at least nine months during the next field season for surveys, particularly in Tyler County, and also around Austin and San Antonio.

UTAH.

The soil-survey work of 1899 and 1900 has been discontinued in this State, but it is proposed to assign a party for six months during the next field season to survey the irrigable lands around Utah Lake.

The work around Salt Lake City is being followed up by a drainage investigation having for its object the reclamation of some of the alkali lands.

VERMONT.

A strong demand is made for the extension of the soil survey in the Connecticut Valley in the interest of the tobacco growers, to see if the cultivation of the Sumatra tobacco can not be extended to that latitude. It is proposed to assign a party for three months during the next field season to extend the soil survey of the Connecticut Valley.

VIRGINIA.

During the last fiscal year the Bedford area and the Prince Edward area have both been completed, and the Harrisonburg area has been begun. All of this work has been under the direction of Mr. C. N. Mooney. It is proposed to finish the Harrisonburg area and the northern part of the Buckingham sheet of the Geological Survey during the present field season, and to assign a party to this State for nine months during the next field season to survey the southern half of the Buckingham sheet and the whole of the Harpers Ferry sheet, as well as an area around Norfolk.

The most important work has been done on the Bedford and Harrisonburg areas. These include portions of the Piedmont Plateau, of the Valley of Virginia, and of the intervening mountain area. The results of the work on the plateau and in the valley are important, but the greatest interest centers in the survey of the mountain soils, in which the fruit interests are developing. It has been found that the different varieties and types of fruit are best adapted to different soils, and as the survey extends and these soils are being outlined the basis is presented for the most intelligent development of the fruit interests.

The Harpers Ferry area will take in a considerable portion of the valley, as well as of the plateau, and the results of the work should show the reason for the decline in agricultural value of the valley soils, and should suggest means for reviving the agricultural interests of what was once a prosperous community on what was considered the highest type of agricultural land.

The survey around Norfolk will be in the interest of the truck growers.

WASHINGTON.

During the past fiscal year the Walla Walla area, covering about 150 square miles and including practically all of the irrigable lands of that locality, was surveyed under the direction of Mr. Holmes. The work has just been finished and the results can not yet be reported.

WISCONSIN.

No work was done in the past fiscal year in this State, but Mr. Jay A. Bonsteel was assigned on July 1 of the present fiscal year to the Janesville area to survey the soils around Janesville, Stoughton, and Edgerton. This survey is in the interest of the tobacco growers, and is particularly to see if the Sumatra tobacco is likely to be adapted to this section, and to be a basis for the improvement of the type of tobacco at present grown.

It seems desirable to assign a party to this State for six months during the next field season to make a survey, particularly of Eau Claire County.

WYOMING.

No soil surveys have as yet been made in this State, but it is proposed to assign a party for six months during the next field season to survey the soils of the irrigable part of the Laramie sheet of the Geological Survey.

ESTIMATED COST OF PROPOSED SOIL SURVEY WORK.

During the fiscal year 1902 about $40,000 was spent on the soil survey with 10 survey parties. For the fiscal year 1903 an allotment of $60,000 has been made for this work with 15 soil survey parties. For the fiscal year 1904, for which estimates are being submitted to Congress, on the basis of the plans which have just been given for the continuation and extension of the work in order to meet the most urgent demands, an allotment of $120,000 would be necessary. This is based upon a total estimate of 243 months of field work contemplated by the above plans, which will require for its completion within the fiscal year 30 field parties, costing approximately $4,000 each, calculated on the basis of the work done during the last three years. Each party would survey about 1,200 square miles, making a total estimated area of 34,800 square miles, or 22,272 acres, in 38 States and Territories, which would be surveyed in that year.

Publication of the Report and Maps.

The results of the field work of the Bureau of Soils are published under authority of the joint resolution of Congress providing for the printing annually of the Report of Field Operations of the Division of Soils, Department of Agriculture, approved February 23, 1901. Under the interpretation of this resolution by the Public Printer, the report and accompanying papers have to be published at one time in a single volume, with the maps in a separate case. This is undesirable in many ways, for work that is finished in the winter or spring has to be held in the office until the succeeding February, when the report of the field work is all completed and sent to the Public Printer. This delays the publication for nearly eighteen months after the work is completed, and the public interests require that the work should be published as soon as possible after the completion of the field work. Furthermore, the publication of all the reports and maps in a single volume makes a bulky and expensive book to send to any person requesting information about a particular area. The demand also is so great that, although the Department has 8,000 copies of the bound report to distribute and the Senate and House of Representatives have together 9,000 copies, the Department received upward of 2,000 requests for the 1900 report which could not be filled. Reprints were ordered of all the reports, in editions ranging from 500 to 1,500 copies, and these were quickly exhausted. As the work becomes better known, many requests are coming from Senators and Representatives, and the opinion is freely expressed that the full value of the work can not be secured unless there is a liberal provision for its distribution within the area in which the work has been done. The requests for reprints of the 1901 report indicate that from 3,000 to 10,000 copies will be required to satisfy the demand, notwithstanding the fact that some of the States are ordering reprints of the maps for their own distribution.

In view of these facts it is recommended that the joint resolution be so amended as to permit of the Report of the Field Operations of the Bureau of Soils being published in parts or volumes as the work is completed. That there should also be reprinted of the separate reports, with their accompanying illustrations and soil maps, editions sufficient to allow 500 for each Senator to whose State the survey relates, 2,000 for each Representative in whose district the survey may be made, and 1,000 for the use of the Department of Agriculture. This will insure the prompt publication of the results of the survey and a distribution through members of Congress, which my present information seems to indicate is desirable if the full value of the soil survey work is to be attained in the dissemination of the information thus gathered, promptly and freely, to the people who are interested.

Needed Legislation for Insular Surveys.

It seems desirable that the benefits derived from the soil survey work should be extended to the insular possessions of the United States, and I recommend that the act making appropriation for the Bureau of Soils be so worded as to permit of the sending of soil survey parties to Porto Rico and Hawaii. Numerous demands have come for the extension of the work in both Porto Rico and Hawaii, and it seems probable that the work will be of particular value to these islands in the present state of the building up of their agricultural resources.

The work has already been started in Porto Rico and in the Philippine Islands, the latter through cooperation with the War Department and the civil government of the islands, in the detail of Mr. Clarence W. Dorsey to the Philippine government and the defraying of his salary and the expenses of the soil survey work by that government. The work can not be continued in Porto Rico nor started by the Department in any other of our possessions without a change in the wording of the appropriation act.

Investigations in Soil Management.

In the development of the soil survey many questions are presented of the possibility of improved methods of cultivation and handling of the crops, as well as of introducing new methods, new crops, and new industries. Some of these suggestions need more time and more study than can be given by the soil-survey parties in the limited time in which they remain in an area. Furthermore, the presentation of such suggestions in printed reports is apt to fail of securing proper recognition from the conservative farmer, who follows pretty much the methods used by himself and his predecessors on the land. Without these further studies and a practical demonstration of their efficiency many of the important results of the soil survey are liable to be lost.

For these reasons a division of soil management has been instituted in the Bureau, in charge of Prof. Franklin H. King. During the past year exceedingly delicate methods have been devised for the analyses of soils in the field. They are so sensitive that the amounts of nitrates, phosphates, sulphates, and the like which may be present, as indicated by water solutions, can be determined to within 4 or 5 pounds per acre 1 foot deep. With these methods it is possible to detect throughout the year fertilizers which were applied in the spring, and to trace the movement of these fertilizers from the place where they were applied down through the different depths of the soil. It has been found possible to show noticeable differences in the chemical composition of the soil in the same field, in some parts of which the crops are growing well, and in other parts of which they are but poorly developed. It appears that the time has arrived, looked forward to with much interest by scientists and practical men alike, when an analysis will show the need of any particular soil for certain fertilizers. It is too early to make a positive statement of this kind, but the indications are that this can soon be accomplished.

A considerable amount of work has been done with these methods on the soils of eastern North Carolina and of Wisconsin, and quite recently many of the important soil types which have been established by the Bureau in Georgia, North Carolina, South Carolina, Virginia, Maryland, New Jersey, Pennsylvania, and Wisconsin have been analyzed by these methods. These types represent all grades of soil, from the most productive to those which are quite unproductive; soils that are adapted to truck crops, tobacco, fruit, wheat, and corn; and soils under a range of climatic conditions with rainfall varying from 25 to 45 inches per annum.

The results of this work have led us to look upon the soil moisture as a great nutritive solution existing over the surface of the earth, the composition of which is everywhere approximately the same. The soil is a heterogeneous mixture of minerals, the predominant ones being silica, feldspar, mica, and other like silicates, resulting primarily from the disintegration and decomposition of igneous rocks, spread out often through the action of water over vast areas of land. All these minerals are but slightly soluble, and it is not unreasonable to expect that such a heterogeneous mixture of silicates in contact with water should yield a soil solution having sensibly the same composition and concentration. The older experimenters in Germany found that in making up solutions for water culture or for sand culture the concentration and composition of the nutritive solution must be the same within relatively narrow limits for success in plant development. The results of the past season indicate that the differences in the composition and concentration of the dissolved material in the soil moisture of various types of soil of widely different localities and of different agricultural values are little if any greater than the differences to be found in one and the same type of soil under good and under poor farm management.

The "early truck" soil of the Atlantic coast may be deficient in plant food and may require fertilizers for the best development of the crop, but even with such an application as would make these soils as rich in plant food as the prairie soils of the Middle West, these light truck soils could not economically be made to produce as large corn crops as the prairie soils. The difference in the agricultural value of these different types appears to depend not so much upon the chemical composition as upon the physical properties of the soils, and especially upon their relation to moisture. In other words, the chemical characteristics of the soil influence the yield of crops, while the physical characteristics have generally the greater importance in determining the kind of crop adapted to the soil.

This work will require much further investigation before these statements can be definitely proved, but the amount and character of the evidence so far obtained is such that these ideas may be taken safely as working hypotheses. They are now serving us in this capacity in suggesting and giving direction to studies which are confidently believed to have far-reaching importance for agricultural methods and practice, studies which in all probability could not have been conceived or planned without the investigations which have just been briefly outlined. The results of the work indicate, as might be expected, that the composition of the soil moisture is largely influenced both by the cultivation and by the cropping of the soil, and appear to show in what way and to what extent cultivation can be depended upon to change these important characteristics.

The results of the last year's work also seem to indicate the very superficial nature of the droughts which so seriously affect crops in the Eastern and Middle Western States. It has been frequently observed that in a time of drought, when the surface soil becomes desiccated and the plants are suffering, the subsoil at a depth of 1 or 2 feet contains but little less than the average amount of moisture, and it has frequently been observed that the crops are much more shallow rooted than they are in the far West. This has been variously ascribed to the uniform texture of the soils and subsoils in arid regions, and to other reasons, but the true explanation seems to be that with our frequent and excessive rains in the spring and early part of the growing season, the crops find sufficient moisture near the surface and develop a superficial root system. When the drought comes and the surface soil loses its moisture, the crop suffers because it is not provided with a deeper root system. In the far West, where spring and summer rains are rare, the crop is planted upon a soil which is always uniformly moist to a considerable depth, and with no subsequent rains the plant develops a deeper root system, which enables it to survive long periods of drought that would seriously affect it if it was subjected to frequent showers during the early period of its growth. It is a familiar fact that a lawn which once is watered during a dry season will have to be frequently watered or the grass will suffer oftentimes more than if it had not been watered at all. The first watering induces a superficial root development, which must be supplied frequently with water. What can be done to prevent this tendency and to overcome the effect of droughts is a subject of the utmost importance, and one which will receive the attention it deserves.

I know of no line of work which has been undertaken of more fundamental importance than the work of the division of soil management, nor one which offers a promise of more valuable results to the agricultural interests. When these fundamental problems have been established they will give a reliable basis for the development of better methods of cultivation, fertilization, and of cropping.

Tobacco Investigations.

Since my last report the commercial success of the shade-grown Sumatra tobacco in the Connecticut Valley has been assured. Last year 41 acres of shade were erected by 13 farmers, cooperating with the Department of Agriculture, 35.88 acres of which were planted to Sumatra and the rest to the ordinary Connecticut Habana seed tobacco. The expenses of this work, amounting on an average to about $657 per acre, were borne by the farmers, the Department of Agriculture exercising supervision over the work and directing all the operations. The Department also reserved the right to offer the tobacco for sale, for the purpose of obtaining official information as to the commercial value of the product, which it would have been impossible to obtain if the tobacco had been disposed of at private sale. Accordingly, after it had been carefully cured and assorted under the direction of the Department's experts, the tobacco was catalogued and offered for sale at public auction at Hartford, Conn., on May 1, in accordance with the wishes of the various growers. A committee of tobacco brokers, with Hon. E. Stevens Henry, Congressman from the First district of Connecticut, as chairman, was invited to cooperate with the Department in the management of this sale. The committee consisted of Messrs. M. E. Flaherty, New York; Steven G. Ruth, New York; S. M. Seymour, New York; Capt. Darius Ferry, New York; James Ertheiler, New York, and Herman G. Vetterlein, Philadelphia.

The committee took a great deal of interest in the work and rendered very efficient services in the matter. Credit is due them for the time and expense which they personally contributed in the interest of this investigation and of the Connecticut growers.

The tobacco was offered for sale at public auction from sworn samples. As each grower wanted to sell his crop independently of the others, many of the bales had mixed sizes and even mixed grades. Furthermore, the leaf had not been tried by the manufacturers, and there was some hesitancy in bidding on this account. This accounts for the considerable variation in the price. It is estimated by the Department's experts, as stated in Bulletin No. 20 of the Bureau of Soils, that the tobacco cost on an average, baled and ready for market, about 51½ cents a pound. The ordinary tobacco grown in the open fields in Connecticut brings on an average from 18 to 20 cents a pound. The average price paid for the shade-grown tobacco was $1.20 a pound, the price varying from $2.80 per pound for the best to 25 cents a pound for some of the mixed bales. The crop that brought the best price sold for $1.63 per pound on the average.

On the whole, it is believed that the auction sale was very satisfactory, but it is thought that the prices for this year's crop will be even higher, as indicated by the great demands for the product and by the favorable reports that are coming in from the cigar manufacturers who have used this leaf. The aggregate of the prices obtained at the auction shows a very handsome financial transaction.

The total area cultivated in Sumatra tobacco in 1901 was 35.88 acres. There were produced 51,308 pounds of cured tobacco, and actually baled 41,046 pounds, the difference being the loss on account of fermentation, trash, and filler leaves. The total cost of production, estimated at $657.17 per acre, was $23,579.26. The total value, estimated at $1.20 per pound, the average price obtained at the sale, was $49,255.20. This gave a net profit to the growers of $25,675.94, or 108.8 per cent. This does not include the cost of the land, barns, or warehouses, nor the interest on the investment so represented, but does include the whole cost of the shade, the framework of which is expected to last for from five to eight years. The profits per acre were as follows: Of baled tobacco, exclusive of trash, there was obtained 1,144 pounds per acre; the cost of this was approximately $657.17 per acre; the value, at $1.20 per pound, was $1,372.80, giving a net profit of $715.63. The best crop, which was raised on a lot of about 6 acres, gave a yield of 1,026 pounds per acre; the estimated cost was $649.86 per acre; the total value at $1.63 per pound, the average price obtained for this lot, was $1,672.38, giving a net profit of $1,022.52 per acre.

A great deal of interest has been felt, of course, as to the experience of the cigar manufacturers in handling this product, and the reports have been anxiously awaited. Very favorable notices have been published from time to time in the press and various trade journals, but in order to obtain direct and reliable information the Department addressed three of the largest cigar manufacturers in Hartford and vicinity, who it was known had purchased some of the stock at auction. In reply to these inquiries the following letters were received:

HARTFORD, CONN., *August 25, 1902.*

DEAR SIR: I beg to inclose you my foreman's report on shade-grown tobacco. (Mitchelson, 1901 crop.) The appearance of the crop in the sheds this year shows an improvement in color; there are more brown leaves, with less of the green cast so much in evidence last season. I hope the growers will make a special effort to raise shade-grown wrappers only on land that produces a sure burn. This type is only for wrappers, and a perfect burn is quite important.

Respectfully, yours, CHARLES SOBY.

Report to Charles Soby by E. M. Roszelle, foreman of factory, on test of shade-grown wrappers, Mitchelson crop, 1901.

Shade-grown wrappers, as tested under my supervision, will show some remarkable results as to yield of product and of the effect on quality of cigars by their use. By comparison with a like quantity of imported Sumatra wrappers as to yield in product, the difference in favor of the shade-grown wrappers is apparent to all.

Our test on one bale of shade-grown wrappers of 155 pounds net weight shows the enormous yield of 85,432 cigars, an average of $29\frac{1}{35}$ ounces per thousand. The same stock, as prepared by the tobacco strippers for the workmen's tables, shows an average of $27\frac{3}{4}$ ounces per thousand, which includes waste of all descriptions in the stripping room. Our tests on imported Sumatra wrappers of same weights show an average of 70,000 cigars to the bale, with greater loss in stem and wrappers in preparation.

In casing for the stripping room, the shade-grown wrappers take the water very nicely and show no bad effects, the wrappers being much easier handled by the caser than Sumatra. It does not become matted, but separates without any trouble.

The workmen find no difficulty in working the leaf, as no loss of time or product is caused by the use of shade-grown wrappers. The leaf is very elastic, and works well by comparison with other wrappers tested by us.

The quality of the shade wrappers is excellent, and blends very well with our binders and fillers. I am positive the cigars are improved in quality by its use. I find no trouble with the burn of the leaf in my daily inspection of the wrappers. I have failed to find a single leaf that does not burn perfectly.

As to color, they are not perfect in all respects. I find that about 91 per cent of the stock tested by us was good in color.

All things considered, the points in favor of the shade-grown wrappers may be summed up as follows:

First. Greater yield in product.
Second. Leaves are lighter in weight and color.
Third. Less waste and cost in preparation for workmen's tables.
Fourth. Less loss in weight of stems as compared with Sumatra wrappers.

Respectfully, yours,

E. M. ROSZELLE.

SUFFIELD, CONN., *September 4, 1902.*

DEAR SIR: It is but right I should advise you as to the working quality of the Connecticut shade-grown Sumatra tobacco, from which I purchased at the sale in Hartford, Conn., on May 1, 1902, 20 bales.

I have worked in my cigar factory since then quite a proportion of this tobacco, and I am more than pleased with the results. It is finer and better in every way (in color, texture, and flavor) than the imported Sumatra, and the wrapping qualities are enormous; 20 ounces will easily wrap 1,000 5-inch cigars. I am confident that when cigar manufacturers come to work this tobacco the demand will be far greater than the supply.

Very respectfully, yours, L. P. BISSELL.

HARTFORD, CONN., *September 1, 1902.*

DEAR SIR: We have been using the shade-grown tobacco, which we bought at the auction held in this city last May, to some extent all summer. We are using it on a small "perfecto" cigar. It wraps with about 2 pounds to 1,000 cigars. The colors have improved a great deal since last spring. It burns well and tastes well. So far we have not had any complaints from any of our customers about the cigars with this wrapper. We should like it better if it had a little more body, because then it would stand the cold weather better.

Very truly, yours, LEICHKE & PLETCHER.

In another communication Messrs. Leichke & Pletcher report that they could wrap 1,000 of their 5-inch cigars with 1 pound 10 ounces of the leaf, while Mr. Bissell, of Suffield, reported that he was using 2 pounds of the shade-grown leaf to wrap 1,000 of his cigars, and that with a bale of wrappers weighing 140 pounds 102,000 cigars were wrapped. It can safely be said, therefore, that the leaf has successfully stood the test of the cigar manufacturer.

Even before the tobacco was ready for the market or the results of the sale announced preparations were made by the growers to largely increase the acreage. Although the commercial success of the investigations had been fully demonstrated, the industry was so important and involved such an expenditure of labor and capital that, at the earnest solicitation of the growers, the Department's experts were left in the Connecticut Valley for another year to advise with such of the growers as needed their assistance. At the present time the Department is advising and instructing in this way 38 growers in Connecticut and Massachusetts, cultivating 645 acres of shade tobacco. The efforts of the Department in this direction seem to be very highly appreciated.

The season has been distinctly unfavorable. There has been an unprecedented amount of rain, falling in very severe showers, and the season as a whole has been characterized by cool spells and especially cool nights. This has apparently not affected the crop materially, as it is the general belief that the crop at this time is better than that of last year. The season has also been one of unusually severe wind and hail storms. Considerable damage has been done to the outside crops in certain sections of the State, but no damage has been done to the shaded tobacco, as the cloth has protected the leaf from all injury from hail. The damage from wind has also been exceedingly light. The winds have been so strong in places that the posts have been lifted from the ground, but the damage to the tents has been exceedingly slight and there has been practically no injury to the crop.

As to the financial prospects for this year, the following estimate is based on the experience of last year: There are about 700 acres of tobacco under shade, which will produce about 1,000,000 pounds of cured tobacco, or 800,800 pounds of baled tobacco, exclusive of trash. The total cost, at $657.17 per acre—the average for last year—will amount to $460,019. The total value of the baled tobacco at $1.20 per pound, the average price obtained at the auction, will be $960,960. The net profit will be $500,941. It is believed, however, that the cost per acre will be considerably less than last year, and that the price per pound will be greater. The Department believes that this industry has been successfully placed upon a commercial basis, and that there will be a considerable increase in the crop grown next year. We have demonstrated our ability to produce a leaf which is desired by our people, and for which about $6,000,000 have annually been expended in foreign countries. The demand for this product has always been greater than the supply, and prices have been maintained in a remarkable manner. It may seem strange to some that manufacturers can afford to pay such prices for wrapper leaf, but even at

$3 a pound for leaf that will wrap at the rate of 2 pounds to 1,000 cigars, the cost of the wrapper is about six-tenths of a cent. Even at such prices the leaf can profitably be used on a 5-cent cigar. There is so little waste to the leaf, it yields so well in the manufacture of cigars, the color is so uniform, and the grading is so perfect that manufacturers find it actually cheaper to pay $3 a pound for such leaf than to buy domestic wrappers at an average of 20 cents a pound or selected domestic wrappers at from 50 to 60 cents.

SUMATRA TOBACCO IN LOCALITIES OTHER THAN CONNECTICUT.

Considerable interest has been shown, of course, in the possibility of extending the Sumatra tobacco industry to other localities and to other States. It was predicted, as a result of the soil survey of the Lancaster area, Pennsylvania, that the Sumatra tobacco could be successfully grown under shade on the narrow strip of Donegal gravelly loam bordering the Susquehanna River. Experiments carried on this year by the Pennsylvania experiment station, in cooperation with this Department, in growing Sumatra tobacco under shade on a small tract of about 1 acre appear to have demonstrated the correctness of this prediction. The crop has been harvested and, judging from the product in the curing shed, it is of good quality. It is not believed by the Department experts that equally successful results will be attained on other soils in this area.

In response to demands from one of the principal New York tobacco districts, a soil survey was made this season of the Big Flats area in the Chemung Valley, New York. As a result of this survey, it is not believed by the Department experts that any considerable success will attend the growing of Sumatra tobacco on the soils of that locality, with the exception of a very small area of not exceeding 10 acres, where an experiment has been actually carried on by a gentleman familiar with the soils of the Connecticut Valley, who selected this tract because it represents the type of land that is found in Connecticut.

A soil survey has also been made of a considerable area in the Janesville area, Wisconsin. Two experiments of growing Sumatra tobacco under shade have been tried there, and the results at the time of harvesting indicate a fair degree of success. The Department does not believe, however, that the product of the soils of the Janesville area will approach in quality or in value the product raised in the Connecticut Valley. It is not intended by this to imply that the leaf can not be successfully grown in the Wisconsin area, but from the information at present obtainable it does not seem that the product will be of equal value with that of the Connecticut Valley. The Department is still of the opinion that the conditions essential for the raising of a high grade of Sumatra tobacco are limited in extent and can be closely defined by the soil survey.

INVESTIGATIONS IN THE FILLER TOBACCO DISTRICTS.

The experiment of raising Cuban filler in Lancaster County, Pa., last year was not a success. It is believed, however, that this was due to a misunderstanding with the growers and a consequent lack of care and thoroughness in the cultivation and handling of the crop. While it was thought that these investigations should not have been interrupted or discouragement felt at the lack of success in this first attempt, it was impossible for financial reasons to maintain a party in Pennsylvania, as a promise had already been given to start the work in

Ohio. Accordingly, more careful plans were made, and a crop was grown on the upland soils of the Miami Valley, under the direct and immediate supervision of the Department's experts. This crop has just been harvested, and it is too early to determine the value of the product. From other crops that have been raised in the locality from imported Cuban seed, which have been fermented by our experts and thoroughly examined, it would appear that a desirable type of leaf, approaching very closely the imported Cuban leaf, can be produced. The quality of the leaf is not at present all that could be desired. There is something harsh about the aroma, but it is thought that this can be considerably toned down, if not entirely eliminated, by thorough methods of cultivation and fermentation.

The tobacco situation in Texas has been thoroughly studied, and it is thought that a desirable leaf will be produced there by careful methods of cultivation, fermentation, and assorting.

CONFERENCE OF TOBACCO EXPERTS.

A conference has recently been held in Washington by the tobacco experts of the Department to consider the general situation and to advise as to the methods to be pursued during next season, especially in Ohio and Texas. Arrangements have been made for experimentation during the coming crop season with good prospects of producing fine filler tobacco in these two States. Leaf has been grown that can not be distinguished from the imported Cuban when properly fermented.

SALARIES OF TOBACCO EXPERTS.

The demand for experts to carry on tobacco investigations has been so great that Mr. Floyd, although receiving as high a salary as, in justice to other officers of departments, it seemed possible to pay him, and who at the time was getting a larger salary than the Chief of the Bureau who was directing the work, was induced to leave by the offer of compensation about three times as great as he was receiving in the Department. Quite recently his successor has been approached in the same way by a corporation intending to operate in the Connecticut Valley, and it is likely that he will leave the Department to accept a much more remunerative position outside. Two years ago I had to note the loss to the Department of a gentleman who had made some important discoveries in tobacco fermentation, and who was called to Japan at a salary about four times as great as he was receiving in the Department.

It is gratifying to feel that the Department's experts are looked upon with such favor in the commercial world, but these experts are so difficult to obtain, and to train them requires so long a time, that the Department is very greatly embarrassed when they are thus removed because of lack of opportunity to pay them what their services are worth in commercial lines. As this work has been developed by the Department, it seems strange to think that the very success of the work is hindering, if it does not prevent, the successful extension of the investigations.

EXTENSION OF THE TOBACCO INVESTIGATIONS.

The tobacco investigations of the past two years have been carried on with three field parties, at a cost of about $5,000 each, or an aggregate of $15,000 per annum. On account of the great success of this work, and the extraordinary interest taken in its extension to other areas, I recommended last year that the appropriations for the Bureau of Soils be increased so that the allotments for this work could be made sufficient for seven parties of tobacco experts. The appropriations as passed, however, did not allow of this increase, and the allotment this year has been the same as for last. The demands for the services of these tobacco experts have been very great, and I would recommend that three additional parties be organized for work in Pennsylvania, Wisconsin, and North Carolina. This will mean an increase of $15,000 in the allotment, making in all the sum of $30,000 for the tobacco investigations. I feel that the economic results of the work so far done, and the lines of work that are at present being developed, fully justify this recommendation. The reports from the Connecticut Valley alone indicate that nearly $1,000,000 worth of Sumatra tobacco will be grown in the State this year. This has largely increased the price of land; has furnished a market for thousands of chestnut posts from adjacent ridges which have lain idle and unproductive for years; has given employment in a healthful occupation and at remunerative wages to large numbers of men and women; has brought about the production of millions of square yards of cloth by the cloth manufacturers, and has opened up the possibility of an enormously profitable industry for the future. It would seem that this experiment alone would fully justify the increase in the allotment that is asked, but when it is stated that we expend annually $8,000,000 for filler tobacco which the experts of the Department believe can be produced in this country, it but adds to the justification of the request for the larger allotment for this work.

Drainage Investigations.

During the year an investigation was started as to the possibility and practicability of reclaiming the soils in the arid regions which have been injured by seepage water and the accumulation of alkali. In cooperation with the Utah experiment station and Mr. C. D. Swann, of Salt Lake City, who has donated land for the purpose and has paid a considerable portion of the field expenses, a tract of 40 acres of alkali land near Salt Lake City has been thoroughly underdrained with tile. This work has been under the immediate supervision of the Department experts, and the work of reclamation is to be under the joint charge of the Department and the Utah experiment station. It is too early yet to speak of the results of this work. It is being watched with the greatest interest by the people of that locality, and it is believed that if the investigation is a success ample capital will be forthcoming to carry on extensive operations in the reclamation of alkali tracts and the prevention of damage to irrigated lands from seepage waters. This work is under the immediate charge of Mr. W. H. Heileman.

Arrangements are being made for the carrying on of similar work at Fresno, Cal., and it is proposed to extend this work to a typical area in Montana and possibly in Arizona, to demonstrate to the people that these unfavorable conditions can be economically controlled. It is estimated that land values in the immediate vicinity of Salt Lake City will be increased at least $3,000,000, exclusive of the cost of reclamation, if they can be reclaimed from the alkali with which they are now impregnated, and it is believed that equally great benefits will result in other portions of the arid West.

In furtherance of this work, Mr. Thomas H. Means, of the Bureau of Soils, has accompanied Mr. Thomas H. Kearney, of the Bureau of Plant Industry, on a trip to Algeria and Egypt to study the treatment of alkali lands, the use of alkaline waters in irrigation, the methods used in the reclamation from seepage water and alkali, and the crops adapted to alkali soils. This investigation has not yet been completed, but sufficient has been heard from the party to indicate that conditions even more serious than those existing in the arid regions of this country are under perfect control, and it is believed that the information thus gathered will be of great benefit to the people of Western America.

BUREAU OF CHEMISTRY.

Examination of Imported Food Products.

The Bureau of Chemistry has continued the examination of imported food products for the purpose of determining if they contain any added substances injurious to health. The Bureau has also collaborated with the Treasury Department in controlling the polarizations of imported sugars and in determining the character of certain other imported products in order to classify them for dutiable purposes. Investigations of the adulteration of food products is one of the important studies of this Bureau, and the work has been especially devoted during the past year to the adulterations of olive oils, with the object of securing an honest market for the olive oils of domestic manufacture which are compelled to compete with cheaper and adulterated oils.

Investigations of Forest Products.

Important investigations, in cooperation with the Bureau of Forestry, have been conducted by this Bureau in connection with economic forest products such as tannin, gums, rubbers, and wood pulps.

Laboratory Tests of Road Materials.

The road material laboratory of this Bureau, which was established in December, 1900, in cooperation with the Office of Public Road Inquiries, tests road materials of all descriptions, free of charge, for practical road builders throughout the country.

Those interested in the construction of a road have only to send samples of their available materials to this laboratory and have the road-making qualities of these materials determined. In the case of materials for macadam roads, the resistance of wear to rock, its cementing value, hardness, toughness, and absorptiveness are determined. After such tests are made it is possible to predict which material will give the best practical results under a given traffic.

Only practical road builders of much experience realize the large amount of money which can be wasted through an improper selection of material. There are generally several materials available in every locality, and the difficulty of selecting the most suitable for a particular road is evident. The only way a proper selection can be made within a reasonable time is by means of physical and chemical laboratory tests.

The laboratory is now equipped for the testing of road materials of every description, as well as cement and concrete for drains and highway bridges.

The large number of samples received from all parts of the country, including our island possessions, attest the value which practical road builders place upon these laboratory tests.

INVESTIGATIONS IN THE SUGAR LABORATORY.

Important investigations looking to improving the quantity and quality of table sirups have been made in the sugar laboratory, and critical studies have been undertaken of the influences tending to produce the maximum content of sugar in beets, melons, and other sugar-producing plants.

STUDIES OF INSECTICIDES.

Studies of the various insecticides in common use in agriculture have been conducted with the object of determining the value of their constituents. Since arsenious acid is one of the most common constituents of insecticides, an investigation has been commenced to determine the effect of this body upon the foliage of plants and to ascertain whether any of the arsenic thus applied for insecticidal purposes is found in the food products derived from the plants which have been thus treated.

STUDY OF ENVIRONMENT OF CHEMICAL COMPOSITION OF CEREALS.

Extensive collaborative work has been instituted with many of the agricultural experiment stations for the study of the effect of environment on chemical composition of wheat and other cereals and to ascertain the most reliable methods for judging the quality of the soils from their chemical constitution.

STUDY OF WATERS USED IN IRRIGATION.

The study of the character of waters used in irrigation, especially in the growing of rice, has been begun, to determine the quantity of injurious salts which these waters may contain and the quantities of this water which may be safely used upon the fields.

ESTABLISHMENT OF NEW LABORATORIES.

New laboratories have been established to study the effects of preservatives and other added substances upon the health of the consumer, with the view of determining the character and amount of such substances which may be safely used in such foods without injury to public health.

A contract laboratory has also been established for the purpose of ascertaining the quality and quantity of materials purchased for the Department of Agriculture and other Departments of the Government, and to establish specifications for such supplies, based on physical and chemical properties.

A drug laboratory has been established also to study the character, standard, and adulteration of drug products. The larger portion of the drugs in commerce are of agricultural and horticultural origin, and the necessity of securing purity and conformity to standards in articles of this kind is evident. Dangerous narcotics and poisonous substances should not be indiscriminately sold, and drugs intended for ordinary therapeutical purposes should conform to the standards laid down by competent authorities.

WORK FOR OTHER DEPARTMENTS.

The Bureau of Chemistry is constantly increasing the services rendered to other Departments of the Government. This is especially true in respect of its collaborative work with the Treasury Department in controlling the polarizations of sugars, and in assisting the appraisers in the classification of other imported articles where the rate of duty depends upon chemical and physical characters.

Extensive studies have also been conducted for the Post-Office Department in regard to the character of canceling inks and stamps used therewith. Similar investigations have been conducted for the Bureau of Engraving and Printing in regard to colors used for printing bank notes, bonds, and other Government securities.

All of this work is of a nature which is highly important to the public service, and is conducted largely on agricultural products.

DIVISION OF ENTOMOLOGY.

Work on Insects from Abroad.

THE SAN JOSE SCALE AND ITS ASIATIC LADYBIRD ENEMY.

In the report of last year attention was called to the exploration which was being conducted by the First Assistant Entomologist, Mr. Marlatt, in Japan and China, to discover, if possible, the native home of the San Jose scale (*Aspidiotus perniciosus*), and also to find native parasites and enemies which might be imported to control or at least check the damage which is done by this insect in the deciduous orchards of this country. Mr. Marlatt's exploration of Japan demonstrated that the San Jose scale is not a native of that country, as many of our entomologists had supposed, but, on the contrary, that it had come to Japan comparatively recently on imported nursery stock, and been thus spread somewhat generally over the islands of the Japanese Empire. Subsequent to the time covered by the report for 1901, viz, in the late summer and fall of that year, Mr. Marlatt extended his explorations to China, examining the coast region from Shanghai northward to Pekin. The evidence from native fruits and wild plants in the region about Pekin and south of the Great Wall established very clearly that the original home of the San Jose scale was in this region.

In brief, this scale insect was found on wild haw apples, native crab apples, and native pears grown in the region indicated where no foreign fruit stock had ever been introduced. Furthermore, it was found in scattering numbers everywhere, just as one would expect in the native home of a pest of this sort where it is normally kept in check by natural enemies. There can be no doubt that at last its original home has been located. It was probably brought to America many years ago on imported Chinese flowering peaches or some other ornamental or flowering shrub from this region, having first appeared in the gardens of a great importer of ornamental and other plants in San Jose, Cal. A very interesting fact in connection with this discovery was the finding in this same region of a ladybird which preys on it naturally and seems to be the principal agent in preventing its often becoming very abundant and injurious. This ladybird (*Chilocorus similis*), a European and Asiatic species, in China feeds naturally on the San Jose scale and related forms, as also on the white peach scale, a very troublesome pest, which has recently gained foothold in our Eastern and Southern States. Several shipments of this beetle were made by Mr. Marlatt, some from Japan and some from China. Unfortunately, all perished but two, this mortality resulting from the long confinement of the six or seven weeks' trip from Asia and the unfavorable conditions under which they were kept in Washington during the winter.

From the two surviving individuals more than 2,000 beetles and larvæ are now on scale-covered trees on the Department grounds. In addition to these, shipments of some thousand beetles have been already made to other points in the East, a number of experiment station entomologists having expressed a desire to assist in the work of propagating, distributing, and establishing this useful ladybird. This importation promises most flattering results at present. It is, however, still an experiment, and what the ultimate benefit will be can only be determined after a two or three years' test. We hope to establish this ladybird in this country and to get from it some of the good results, at least, which it evidently accomplishes in China and Japan. It probably will not render it unnecessary in the future to occasionally spray or otherwise treat infested trees in commercial orchards, but it probably will be of very great assistance in keeping in check the San Jose scale in the thousands of gardens and small orchards of individuals who have no commercial interest at stake and who would not, ordinarily, take any means to keep this scale insect from multiplying on their trees, thus forming centers for contagion.

IMPORTATIONS OF OTHER BENEFICIAL INSECTS.

The preliminary attempts to introduce the European enemies of the gipsy moth have been continued. The difficulties attending the importation of the predaceous beetles from Europe to America are considerable, and to get them established in this country will demand the careful cooperation of agents or interested individuals on the other side.

The black scale of the orange is the most destructive, perhaps, of all the orange pests in California, and the South African parasite of this scale insect, which we have been endeavoring to establish in California for the last year or two, still gives promise of ultimately becoming a fixture and doing the good service in our Western orange districts which it now does in South Africa and in Italy. The history of this importation was given in my report of last year. A recent letter from Mr. Alexander Craw, who is looking out for this experiment in California, reports that the parasite is breeding abundantly. With a beginning of only two female insects kept in captivity, he had sent out to different localities up to July of this year (1902) 25 colonies.

The very important European parasite of the larger scale insects such as the Lecaniums and mealy bugs (*Erastria scitula*) seems on the way to be successfully established in California. It is believed that the introduction of this insect into our citrus and olive districts will be of the greatest advantage to the growers of these fruits. With the cooperation of Mr. Craw, the horticultural quarantine officer, and Mr. Ehrhorn, of Santa Clara, these insects have already been liberated in Santa Clara, Los Angeles, and Niles, Cal., and the outcome of this effort at the introduction of a useful insect will be watched with interest, and the utmost care will be taken to bring it to a successful issue.

Another foreign insect promising great usefulness in a different direction, imported during the past year, is the European ladybird (*Coccinella septempunctata*) sent from Hungary through the kindness of Professor Sajo. These ladybirds feed on plant lice, and should be an efficient aid in controlling the destructive insects of this class which infest cotton, peas, melons, and other vegetables, and the fruits. Some of these insects have been sent to Mr. Craw, in California, where they give promise of becoming established; others to various Eastern experiment station entomologists, and they have also been colonized in the District of Columbia. Another ladybird (*Leis conformis*), a plant-lice feeder also, was imported from Italy and liberated in California. A further importation of this species may be necessary to effect its establishment here.

This entomological work of an international character has not been altogether one-sided. In other words, while we have been importing foreign insects and have been receiving a good deal of gratuitous assistance by entomologists abroad in this work, we have paid our debts, to a certain extent, by sending to foreign countries some of our beneficial insects. The extraordinary success in preventing damage from the white scale, once a great orange pest in California, by the introduction of the Australian ladybird, has been duplicated, as made evident in former reports, in many foreign lands, notably South Africa, Portugal, and Egypt. During the last year colonies were sent from California, at our request, to Dr. Antonio Berlese, Portici, Italy, where this same white scale had established itself. Recent reports indicate that this exportation has proved to be another of the series of successes which has attended this insect wherever it has been sent to work against its notable scale-insect host. A colony of this ladybird has recently been sent, by request of the local board of agriculture, to Papeiti, Society Islands. We have also had sent, through the kindness of Mr. Craw, various beneficial ladybirds to the Bermuda Islands to assist in keeping in check the noxious scale insects occurring on those islands.

The South African Grasshopper Fungus.

The report of last year noted the beginning of an experiment to determine the effectiveness of the African grasshopper fungus as a means of destroying various forms of destructive locusts. The experiment has been continued the present year and much extended, the intention being to give this fungus a thorough and practical test to demonstrate whether it can really be counted on as a means of controlling the locust or not. The number of experimenters last year during the entire season was 223. During the summer of 1902 cultures of the fungus were sent to nearly 1,000 individuals, not including the perhaps even greater number of cultures which have been locally prepared by various individuals, and especially by Prof. C. P. Gillette, of the Colorado State Agricultural College, who has taken charge of the culture preparations and their distribution in his State. These cultures have been sent out to 25 different States and Territories. Results have not yet been tabulated, but some successes have been reported. It now seems probable that very great reliance can not be placed on this fungous disease. Either it does not work with our grasshoppers as readily as it does with the South African locust or our climate makes our species of grasshopper more resistant or the fungus less operative.

The Fig Fertilizing Insect.

As a further report of progress on the introduction and establishment of the fig-fertilizing insect in California referred to in previous reports and especially summarized in the report for 1901, it may be said for the year 1902 that thousands of figs containing the insects successfully withstood the winter climate of California, and an unlimited amount of fig insects was available at the proper time for caprification in the spring of 1902, resulting in the production of some 50 tons of

Smyrna figs in the sole commercial orchard in existence at present, that of Mr. George C. Roeding, at Fresno. It was further found that the fig insect successfully hibernates at Niles, Cal., and there is now no longer any danger of its dying out. In other words, the entomological problem of Smyrna fig culture in America is solved, and what remains to be done belongs rather to the domain of horticulture, namely, the introduction of more caprifig trees, improvement in the methods of curing and drying the fruit, and the determination of the regions throughout the arid West suitable to the industry. The practical success of Smyrna fig culture in California is now only a matter of time. In a very few years Smyrna fig orchards will be in bearing in many places in California and doubtless in other Western States where climatic conditions are favorable.

As stated in the report for 1901, Mr. Roeding spent nearly a year in Smyrna studying the methods of fig culture in that country under a commission from this Department. Much valuable data was obtained, for the most part appertaining to the horticultural side of the problem. The future of this industry, which promises to be one of the great ones of the arid region of the West, becomes more promising every year.

WORK ON THE MEXICAN COTTON BOLL WEEVIL.

The work on the Mexican cotton boll weevil reported in 1901 has been continued, and has the present season been given a very practical status by means of the specific appropriation by Congress for the purpose of $20,000. A field experiment is being conducted on two cotton plantations, one of 200 and the other of 125 acres, under the control and direct management of the Entomologist, to demonstrate that by proper methods the damage from the boll weevil can be so reduced as not to be a serious menace to the production of this important staple in the region in Texas already invaded by the weevil.

In spite of the delayed beginning this year, owing to the late date at which the appropriation was available, the entomological side of this field experiment has been thoroughly successful, and the weevil has been practically eliminated from the plantations under Departmental control. The cotton season, however, in Texas has been the most disastrous one climatically in twenty-five years, and this will prevent the cotton yield on these plantations coming up to the average, the lessened yield, however, in no wise being chargeable to the boll weevil. It is urged that the means for continuing this investigation be provided, as it is one of the very greatest importance for the whole cotton industry of the South. There can be very little doubt but that ultimately the Mexican boll weevil will spread to the adjoining State of Louisiana, and thence across the cotton belt east of the Mississippi, and is capable of becoming one of the most destructive insects in America. If, on the other hand, the Department can demonstrate by practical field work that the weevil can be controlled, as indicated by the preliminary experiment this year, it will have the effect of influencing planters generally, in Texas and elsewhere, to adopt the same methods, and thus avoid much of the loss which this insect threatens.

In this connection, reference may be made to the Egyptian cotton which, by newspaper report and otherwise, has been somewhat exploited as immune to the boll weevil. This misconception is capable of doing harm, inasmuch as the Egyptian cotton is rather more subject to weevil damage than the variety of cotton ordinarily grown in Texas. In a field of Egyptian cotton near San Antonio practically every square was punctured by December 12, and the weevils had begun to attack the bolls, half of which had at that date been destroyed. The fact that Egyptian cotton seems to be later in maturing than the smaller American plant causes it to be much more liable to damage by the boll weevil. The same conditions with Egyptian cotton were also noted on another plantation.

In the fall of 1902, after the close of the active field work of the season, the agent in charge made some very desirable explorations in Mexico, more especially to investigate the subject of natural enemies. Important biological and life history studies have been prosecuted in Texas and the present range of the insect has been carefully mapped.

Work on the Codling Moth in the Northwest.

The work done on the codling moth in the Northwest has been continued with very satisfactory results. A detailed report of this work has been published. The work the present year has been of a very practical character, a successful orchard demonstration having been conducted which showed that it is possible to prevent much of the damage which is now annually suffered from the codling moth.

Work on Insects Damaging Forests.

During the first half of the year several important investigations were made of forest insect depredations by Dr. A. D. Hopkins, of the West Virginia experiment station, who was employed at the request of Mr. Gifford Pinchot, of the Bureau of Forestry, as a temporary agent of the Division of Entomology for the purpose. Great loss of pine timber, to the amount of more than 600,000,000 feet (board measure) in the Black Hills Forest Reserve, has resulted from the work of a bark-beetle mining under the bark of living trees. Numerous facts have been determined relative to the life history of this insect, and it has been possible to detail practical methods, the adoption of which will largely decrease future losses. A report of this investigation has been published.

Another investigation was of hickory and other forest trees near Geneseo, N. Y. The hickories had been killed by a bark beetle, the damage having already gone beyond repair for most of the region invaded. Had an earlier report of the difficulty been made to the office, a prompt application of known methods of control would have prevented this loss. A special report of this investigation will soon be published. The damage occasioned by this hickory bark beetle seems to be quite general throughout the Northern United States, and will receive considerable attention in the future, especially now that Dr. Hopkins has been regularly appointed to the Division of Entomology as expert in forestry insects. A study of the insect enemies of Eastern, Southern, and Western pine forests has been begun to determine, if possible, the primary causes of the serious insect damage now being done to pine timber of western North and South Carolina, northern Georgia, southern Florida, the white pine or silver pine of the Pacific slope, the Monterey pine, California, and the pines of Arizona and Colorado. The regions designated have been given a preliminary survey to determine existing conditions, and it is expected that by the close of the next fiscal year it will be possible to have a report ready for publication on the principal pine insects of North America, which will include brief popular descriptions of the more important insects, with illustrations, and recommendations for preventing losses.

Work on Scale Insects.

The important work of the year on scale insects has been the investigation of the San Jose scale in China and Japan, referred to under "Work on insects from abroad." The experimental work on the San Jose scale at home has been continued, and a circular (No. 42) describing the methods of controlling this insect has been revised to include the results of the latest information on methods of treatment.

The Division of Entomology of this Department is looked upon as the chief source of information upon scale insects, few of the experiment stations having collections or literature sufficient to enable the determination of specimens; hence much work is done every year in determining material for station entomologists and for private individuals throughout the country. In addition, many large collections of scale insects have been received for study and determination from foreign countries, notably from Australia, New Zealand, the Bermudas, and Italy.

In the course of the trip of exploration made by Mr. Marlatt in Japan and China, Java, and other countries in the Orient, a particular study was made of the scale enemies of citrus and other fruit trees, and large collections of this class of pests were brought home from the countries visited. The knowledge gained from this study will be of great practical importance. It will acquaint us with the scale pests of these countries, which are being brought into closer commercial relations with the United States, a knowledge which is desirable because these insects are more apt in the future than in the past to reach our shores through importations of fruit trees and ornamental stock. The scale insects of foreign countries are perhaps the most important pests to be considered in all quarantine and other operations looking to the protection of our growers from foreign invasions, since these insects live for the most part attached to the bark of trees and are much more apt to be brought in with plants than are other insects.

Insects Injurious to Shade Trees.

Many complaints of insects affecting shade trees have been received in recent years, and among these are several important foreign species, which have been under investigation during the year.

Insects Injurious to Truck Crops.

The studies already under way on destructive insects affecting truck crops have been actively followed up, and an extensive report on the principal insects that have recently been injurious to vegetable crops has recently been issued. A number of insects injurious to leguminous food crops received considerable attention, and the new facts discovered in the life histories of some of them are of value in suggesting means of control.

Work on Insects Injurious to Stored Products.

Certain insects of this class are increasing their ravages. The Mediterranean flour moth, which is the most troublesome of all insects that are harmful in flouring mills, was reported as injurious in mills in new localities in California, and in Michigan, Wisconsin, and Minnesota. The Angoumois grain moth has also increased in injuriousness in a number of States, particularly northward and in California.

The cigarette beetle has been very destructive during the past season. Thorough investigations were conducted with a view to find a remedy for this pest, and much of value was learned and published.

An exotic cabinet beetle did much injury to silk in New Jersey and to domestic tanned leather in New York City, its introduction being traceable to the introduction of foreign hides. In the treatment of the insects which affect stored products, recent experiments with hydrocyanic-acid gas indicate that this remedy may, in course of time, be found more valuable than the bisulphide of carbon usually employed in the treatment of many such insects.

Work on Insects in their Direct Relation to the Health of Man.

Insects as conveyers of disease to human beings have been the subject of special research by the Entomologist for the past three years. A popular article on this topic was published in the Yearbook for 1901, and has since been reprinted in more popular form. During the past summer many inquiries have been received requesting information and advice on the subject of mosquito and fly control, and these have been answered by the publication in question and by specific advice. This investigation is being actively prosecuted; the field is a very large one and of the greatest importance. While perhaps the principal insects responsible for the transmission of disease have received study, there remains very much yet to be learned of them, and, furthermore, the Entomologist is in frequent receipt of new material from this and other countries, and is constantly discovering new facts bearing on this general problem.

Unclassified Work on Injurious Insects.

During the fiscal year investigations were taken up on supposed insect damage to cocoanut and other palms in Cuba, Florida, and in British Honduras. An article on the principal insects which act as disseminators of the trouble locally termed "fever," and due to a fungous disease, includes suggestions for methods of prevention of the dissemination of the disease.

Insect Determinations.

An important line of work is the identification and maintenance of records of the habits of injurious insects received from correspondents, field agents, and others to serve as a basis for determining the best means of controlling them. During the fiscal year 226 species not hitherto studied at this Department received more or less attention, and the catalogue number of biological series thus studied now reaches 9,667.

The time of two expert assistant entomologists and several minor assistants and aids is devoted to the preparation of material for permanent storage in the United States National Museum, for exchange with other institutions, and for illustration and description.

Experimental Work with Insecticides.

During the year a considerable number of experiments with insecticides and other methods of controlling insect depredations have been conducted. A great many insecticide substances are constantly being advertised, and many of them are sent to the Entomologist for experimental examination and test either from purchasers or the manufacturers. Most of these are of very little value, or are combinations of old and well-known insecticide substances, sold, however, as a rule, under their new form at many times their real cost. The assistance of the Chemist has been invoked to determine the composition of these substances, and he has recently established a special section for insecticide analysis and investigation in cooperation with the Division of Entomology.

To determine the feasibility of eradicating household insects by fumigation with hydrocyanic-acid gas several valuable experimental operations have been conducted, with the result of the establishment of the complete practicability of disinfecting houses by this means. This poisonous gas can be used without risk to human life if the operation is carried on with proper precautions, but no one is advised to undertake it without having fully acquainted himself with the steps in the process as indicated in Circular No. 46 of the Entomologist's office.

Silk Investigations.

The silk investigations authorized by the last Congress have been placed in the charge of the Entomologist. Miss Henrietta A. Kelly has been employed as special agent in silk culture in the South, and is charged with the preparation of a manual of instructions which it is expected will be ready for publication and distribution this fall. She will also look over the ground and select suitable locations for model silk plantations and rearing establishments which may serve as schools of instruction where interested persons and others may come and acquire familiarity with all the steps in the care of caterpillars and the handling of cocoons. The Entomologist, Dr. Howard, during the summer made a careful examination of the silk industry of southern France and of Italy, studying especially the methods of reeling silk and silk manufacturing establishments, mulberry culture, and breeding methods. He has also arranged for the purchase of "seed" or silkworm eggs which can be relied upon as free from disease, and has negotiated for the importation of desirable mulberry stock. It is the intention to follow up this investigation by establishing experimental stations in the South, by cooperative work with some of the agricultural experiment stations which have expressed the wish to assist us in the investigation of silk culture, and also to establish at some suitable point a practicable reeling plant so that the silk cocoons produced in small quantities may be purchased and reeled and the product marketed.

Apicultural Investigations.

In apiculture the work has included an importation of select breeding queens from Italy and smaller importations from Austria and Cyprus. These were forwarded to experiment stations and to bee raisers in different sections of the country. Very favorable reports from these queens have been received, notably from southern California, where, it was stated, while black bees were doing nothing, the Cyprians from the Department importation gathered a fair crop, double the yield also of the best Italians. Various crosses were made between these races and some promising strains secured, one result being that the irritability of some excellent honey gatherers can be modified by using males of gentler races in the crosses.

DIVISION OF BIOLOGICAL SURVEY.

The Biological Survey is charged by Congress with three distinct lines of investigation, each of which is organized as an independent section of coordinate value with the ordinary Departmental division.

The first, or Biological Survey proper, studies the geographical distribution of mammals, birds, and plants with reference to the climatic factors governing distribution, and from this study prepares maps showing the boundaries of the natural life zones and crop belts of the country; the second, or Section of Economic Ornithology, studies the food and food habits of birds with relation to agriculture and horticulture; the third deals with matters of game preservation and introduction.

BIOLOGICAL SURVEY.

California and Texas, owing to their great size, the diversity and commercial value of their agricultural products, and their promise of far greater development in future, have unusual claims on the Biological Survey. In California the work is peculiarly difficult by reason of the extraordinary diversity of the topography and climatic conditions. Not only are there torrid valleys below the level of the sea, and alpine summits towering to elevations above the limit of plant growth; there are also areas of excessive humidity, of frequent fogs and heavy rainfall, and areas of excessive aridity, hotter and drier than the Sahara, where perpetual sunshine is the rule and years sometimes pass without rain.

Owing to the trend of the principal mountains and the influence of the coast fogs, the zones run in the main north and south instead of east and west. Some of the large interior valleys, notably the Salinas, act as flues through which a great volume of fog flows daily at certain seasons, lowering the temperature and increasing the humidity for a distance of 75 miles or more. These great rivers of fog cut off the sun, lower the temperature, and increase the humidity, and by overflowing through canyons and side valleys also reach and exert their influence in numerous tributary valleys and basins, some of which lie between the main fog river and the coast. In these cases the usual conditions are reversed, for ordinarily the valleys of the coast ranges in retreating from the sea toward the interior receive less and less fog and more and more heat and sunshine. Each valley and each mountain slope therefore has its own climatic individuality and its own capacity or adaptability for particular agricultural and horticultural crops. Some are cool enough for apples, cherries, and the sugar beet; others warm enough for almonds, raisin grapes, and citrus fruits. And in the case of some of those in which the same crops may be cultivated with equal success, these crops mature at widely different dates. Thus oranges ripen in southern California from January to April; on the Santa Barbara plain, in July and August; at Oroville, in November and December. Similarly, peaches mature at different points in northern California from May to September, and in Los Angeles as late as November. Cherries are ready for market in Vaca Valley in March and April, while in neighboring valleys they do not ripen until May and June. The great commercial importance of these differences in time of ripening of fruits is obvious.

The native fauna and flora of a region afford a suggestion as to its climatic peculiarities and agricultural possibilities, assisting one to conclude what farm crops and varieties of fruit will or will not be likely to succeed in a particular place. The Biological Survey is making a critical study of this subject, and is engaged in the preparation of maps showing the natural distribution of the faunal and floral areas and consequent courses of the crop belts, and is also preparing lists of the particular kinds and varieties of crops and fruits likely to succeed in each.

The labor of tracing the zone boundaries in California is one of infinite detail, and is rendered still more difficult by the absence of accurate topographic base maps, except of the areas already mapped by the United States Geological Survey.

In addition to the work in California and Texas, some field work has been done in Montana, the Dakotas, Nebraska, Kansas, Indian Territory, New Mexico, Mexico, and Canada.

THE PRAIRIE DOG SCOURGE.

The extension of ranching on the Great Plains has led to serious, widespread, and reiterated complaints of steadily increasing losses from the depredations of prairie dogs. The increase in these pests is the natural result of the destruction of their enemies, chiefly coyotes and the larger hawks. Assistants were sent to various points in the afflicted area, from Montana to Texas, and much information was collected. As a result a circular of directions for the destruction of prairie dogs has been published, and an article on the subject was contributed to the Yearbook for 1901.

Section of Economic Ornithology.

During the year field work on the food habits of birds has been carried on in California and Maryland, and the stomachs of considerably more than 2,000 birds have been examined in the laboratory. Of these, 1,000 were of the game birds, 500 of sparrows, and the remainder distributed among other groups of economic value. A bulletin on the food of sparrows has been published, one on the food of game birds is well advanced, and one including the results of an extended economic study of birds on a Maryland farm has gone to press.

For many years California fruit growers have complained of the destruction of buds and fruit by birds. In order to gain definite knowledge on this subject, the chief of the section was sent to California, where he spent several months studying the food habits of birds in the great fruit-growing districts. Besides observing the food habits and collecting the stomachs of birds killed in the fruit trees, he noted and collected the kinds of wild fruits and seeds, and also the insects found in the immediate neighborhood of the orchards, for aid in identifying the stomach contents of the birds.

Section of Game Protection and Preservation.

Work under the Lacey Act has been continued along three principal lines: (1) Publication of information on game protection; (2) improvement in the inspection service guarding the importation of foreign birds and mammals; (3) cooperation in restricting illegal interstate shipment of game.

Compilations and synopses of game laws have been issued and widely distributed, and are in constant demand. Among the most popular and useful of these are digests of the game laws and of the laws protecting nongame birds for the current year. An annual directory of State officials and organizations dealing with matters of game protection was also published.

During the year 287 permits were issued for the entry of about 200 mammals and 50,000 birds. The imported birds may be classed under two heads—game birds introduced for propagation and birds bought to supply the trade in cage birds. The latter greatly exceed the former in number. The inspection service, which now includes the principal ports of entry of both coasts, and also Honolulu, Hawaii, is now maintained by fees paid by the importers. Importers complain of this, and the Department would be glad to place the inspection service on a permanent basis should Congress make the necessary appropriation. By strict economy the service could be maintained at the three most important ports of entry at a total cost of $1,000 per annum.

DIVISION OF STATISTICS.

The work of the Division of Statistics has been continued on the usual lines. With a view to further improving its crop-reporting service two additional field agents have been appointed, and the statistical expert who has for some years had charge of the crop statistics of foreign countries competing with the United States has been sent to London, England, where he is in closer touch with the statistical offices of the different European Governments, whose reports, along with the most authoritative commercial intelligence of interest to American agriculturists, he transmits to Washington by mail or cable from time to time.

In cooperation with the State Agricultural College of Minnesota a statistical investigation is being conducted by the Division of Statistics into methods of farming, the results of which will have an important bearing on such questions as the relative profitableness of crops, the economical utilization of farm labor, etc.

The work of this Division will shortly form the subject of a special report to Congress.

OFFICE OF EXPERIMENT STATIONS.

Development of the Work of the Office.

The functions of the Office of Experiment Stations have been enlarged in several directions during the past year, and the enterprises previously in its charge have become more extensive. Especial efforts have been made to aid the movement for the strengthening of agricultural education and research through the more definite formulation of agricultural science and the more thorough training of agricultural experts. For this purpose the work of this Office, in connection with the Graduate School of Agriculture, as described elsewhere in this report, has proved to be unusually successful and effective. Attempts have also been made to call the attention of the agricultural public and the managers of educational systems to the great desirability of making agricultural subjects a part of the curriculum of secondary and elementary schools. The development of the farmers' institutes as effective agencies for the dissemination of the results of the work of this Department and the experiment stations has also received attention. The agricultural experiment stations under the direct management of this Office in Alaska, Hawaii, and Porto Rico have been put upon a firm basis, and much progress has been made in developing useful lines of work in these regions.

The Office has been brought into closer relations with the institutions for agricultural research in foreign countries through work involved in the preparation of a bulletin setting forth the organization, resources, and lines of work of these institutions. By this means our knowledge of these foreign institutions has been greatly broadened, and it will be more feasible hereafter to secure definite information regarding their work which will be useful to similar institutions in this country. Both the legal and engineering features of the irrigation investigations have been enlarged, and a beginning has been made of investigations in other lines of agricultural engineering which have hitherto been neglected by this Department. Improvements have been made in the apparatus and methods for nutrition investigations. The results of these investigations have been more effectively brought to the attention of teachers of physiology and domestic science, and beginnings have been made of what it is hoped may develop a systematic study of dietaries in public institutions.

With the expansion of its work the amount of useful material prepared for publication in this Office has materially increased. Special efforts have been made during the past year to publish this material in forms which will contribute to its effective and economical distribution. The performance of duties growing out of the relations of the Department with the Civil Service Commission has also involved considerable work. With the constant and rapid growth of the system of agricultural education and research in this and other countries the general business of the Office in its relations with outside institutions is necessarily enlarged from year to year.

PROGRESS OF THE EXPERIMENT STATIONS.

The feature of the progress of agricultural institutions in this country which has attracted most attention during the past year is the rapid increase in the public interest in these institutions. This is shown in the increase in the number of students in agricultural colleges and schools, in the larger attendance at the farmers' institutes, in the enlarged correspondence and mailing lists of the stations, in the increased demand for trained workers in agricultural and other business enterprises requiring scientific and expert knowledge and skill for their most successful management, and in the wider space given to agricultural education and research in agricultural and other journals.

During the year a number of new institutions for investigations in agriculture have been established in different States. The State legislatures have continued to be very liberal with the agricultural colleges and experiment stations. Over half a million dollars annually are now contributed by the States to the maintenance of the experiment stations.

Evidences of the influence of station work in improving agricultural practice and benefiting the farming interests of the country continue to multiply. This influence is felt in all of the various phases of agricultural operations. It is possible here to briefly refer to only a few recent examples of the practical benefits which are being derived from investigations by the experiment stations.

The origination and introduction of improved varieties of cereals through the agency of the stations of the grain-growing region, cooperating with this Department, is resulting in a vast increase of the grain-producing capacity of the country. As an illustration of this it may be cited that a variety of oats imported by the Department and tested and improved by the Wisconsin station, among others, has been widely distributed and grown, with results which indicate that its general introduction will be followed by an average increase of yield which may be safely estimated at from 3 to 5 bushels per acre. As the acreage of oats in Wisconsin alone in 1901 was, according to our statistician, 2,290,288, producing 66,647,381 bushels, worth $25,992,479, this would mean a gain to the farmers of Wisconsin annually of from $2,400,000 to $4,400,000 on the oat crop alone.

Marked improvement in the yield and quality of wheat in the Northwestern States is resulting from the distribution of improved varieties originated by the Minnesota station. One of the results of the work of the Illinois station on the breeding of corn has been the formation of the Illinois Seed Corn Breeders' Association, a chartered organization, with a limited membership of reputable and well-known corn growers, pledged to select and grow their seed corn according to definite rules formulated by the station and to sell only their own crop. The success of this enterprise has been phenomenal. All of the available supply of the improved seed is rapidly disposed of to farmers and much of it is engaged in advance. The work of this station on corn is proving to be far-reaching in its results, not only in improving the general quality of seed corn, but in inducing practical men to undertake breeding for special qualities—for protein, for oil, or for starch—which the station has demonstrated to be entirely feasible. The influence of station investigations is also being widely exerted in the grain-growing region in the introduction of rotations to conserve soil fertility in place of the exhaustive system of continuous grain cropping heretofore generally followed.

The beneficial effects of the work of the stations in the older States on fertilizers are becoming every year more apparent in the economical purchase and intelligent use of fertilizers by farmers. For example, as a direct result of the investigations and advice of the New Jersey station, organizations of farmers have been formed in the truck-growing districts of that State for the purchase of unmixed fertilizing materials, thus effecting a saving of from 25 to 40 per cent in the cost of their fertilizers, and at the same time securing better results as regards earliness, yield, and quality of product.

The recent introduction into a number of States of a system of inspection by the stations of feeding stuffs, similar to that which has been in force for some time for fertilizers, furnishes a very effective means of protecting farmers against fraud and of inculcating correct ideas regarding feeds and feeding. It is encouraging to note that in many States farmers are now following very closely the advice of the stations regarding the purchase of concentrated feeds and the balancing of rations made from home-grown products.

The rapid extension of the rational use of silage and the very general adoption of the round form of silo is directly traceable to experiment station influence.

Through the efforts of the Department and the stations, the application of insecticides and fungicides as means of protection against injurious insects and plant diseases has become almost universal, and the benefits and profits resulting from the practice are no longer questioned. Striking evidence of the readiness with which farmers and fruit growers will now adopt promising means of plant protection is furnished by the fact that the method of formaldehyde treatment of smut of oats, proposed by one of the stations, was almost immediately put into use by over 25,000 farmers in the State of Wisconsin alone, with the prospect that the number using the method will be vastly increased the next year. As the estimated loss from oat smut in Wisconsin varies from $3,000,000 to $7,000,000 annually, according to the season and other conditions, the value of an effective means of prevention of the disease can be readily estimated.

The Utah station has achieved notable success in its study of the extent to which dry farming, that is, farming on lands in the arid region which can not be irrigated, may be practiced with profit and the conditions necessary to success. This work is bearing fruit in the rapid extension on a safe basis of what has heretofore been a very precarious system.

So rapidly has the demand for the services of agricultural experts spread in different directions that the workers in this service have in many instances been overworked, or, at least, have been forced to dissipate their energies in attempts to cover too many fields. There is, therefore, a most urgent necessity that the number of workers in our agricultural institutions should be increased so as to permit proper specialization of work. The station investigators must be relieved of teaching, lecturing at farmers' institutes, and other services, which, while important in themselves, distract their attention, dissipate their energies, and seriously hinder the progress of effective investigations.

It will be of little use to construct expensive laboratories and equip them with elaborate apparatus unless they are manned with first-class investigators. There is nothing new in this proposition, but the progress of agricultural institutions in this country in recent years makes it imperative that the work of the experiment stations and of this Department as the source of new knowledge on agricultural problems should be raised to the highest grade and kept there. The wider the work of the agricultural colleges, schools, farmers' institutes, and other agencies for the education of our rural population becomes the more important is it that the institutions of research in agriculture should be the best that human wisdom can devise. It is now necessary to insist on this more strongly than ever before, and it will be necessary to reiterate it until the managers of agricultural institutions and the friends of agricultural progress accept this principle in practice as well as in theory. Under present conditions a large number of the experiment-station workers are attempting too many different kinds of work, and the progress of the station is seriously hindered from this cause.

One result of the lack of a sufficient number of well-trained and experienced workers in our agricultural institutions is that the best men are constantly being shifted from one institution to another or are departing to outside enterprises offering larger salaries and other attractions. The past year has witnessed an unusually large number of such changes in the personnel of the experiment stations. This is a very serious matter, since the time element in the conduct of agricultural investigations is an important one. Until the tenure of office in our stations is much more stable than at present we must expect that there will be much waste of work and funds in incomplete investigations due to the frequent shifting of the officers in charge. There is also need of increased funds for the general expenses connected with agricultural investigations.

Cooperation of the Stations with the Department.

During the past year many cooperative enterprises between the different Bureaus and Divisions of this Department and the experiment stations have been continued and contracts have been made for a considerable number of new investigations on this plan. In order to more clearly define the conditions under which such cooperative arrangements should be made a plan was formulated for conducting this work and transmitted to the directors of stations as well as to the chiefs of Bureaus and Divisions of the Department. This has cleared away some difficulties hitherto attending arrangements with the stations, and especially has defined the responsibilities of both the Department and stations in such enterprises.

The work undertaken conjointly with the stations is of the most varied character, but under the system devised there is no friction, and it is believed that much good will result to both the Department and the stations by this close union of interests. In all cases the general policy is to bring about a definite and clear understanding regarding the responsibilities of the Department and the stations, and when this is accomplished the carrying out of the details is a comparatively simple matter. The Department is not concerned with local State problems, but there are questions not bounded by State lines which the Department can take up, and which, with the cooperation of one or more stations, should be earnestly investigated. In this way the Department becomes the medium for the combining of interests in a way that will be helpful to all.

Graduate School of Agriculture.

A new enterprise in agricultural education has been inaugurated by the establishment of the Graduate School of Agriculture, which held a four weeks' session during the month of July, 1902, at the Ohio State University, Columbus, Ohio. The plan for this school was originated by Prof. Thomas F. Hunt, dean of the college of agriculture and domestic science of the Ohio State University, the purpose being to establish a school for advanced students of agriculture at which leading teachers and investigators of the agricultural colleges and experiment stations and this Department should present in some regular way summaries of the recent progress of agricultural science, illustrate improved methods of teaching agricultural subjects, and afford a somewhat extended opportunity for the discussion of live topics drawn from the rapidly advancing science of agriculture. This idea received the cordial support of President Thompson of the Ohio State University, and on the recommendations of these two men the board of trustees of the university voted to establish such a school and generously made provision for the financial support of its first session.

The Association of American Agricultural Colleges and Experiment Stations at its convention in 1901 favored the plan for the school and voted that, if the success of the first session seemed to justify its continuance, it be made a cooperative enterprise under the control of the association. Believing this movement to be in line with the objects for which this Department was created, I gave it my cordial approval, and on my advice the Director of the Office of Experiment Stations consented to act as dean, and other officers of the Department of Agriculture to be members of its faculty. Under these favorable auspices there was little difficulty in securing a strong faculty. As actually organized, this included 35 men, of whom 26 are professors in agricultural colleges, 7 are leading officers of the Department of Agriculture, and 2 are officers of the New York State experiment station. Courses were offered in agronomy, zootechny, dairying, and breeding of plants and animals. The school was housed in the substantial and well-equipped agricultural building of the Ohio State University, where were illustrated the most improved apparatus of instruction in soil physics, dairying, and other agricultural subjects. Besides the live stock of the university farm, leading breeders of Ohio furnished choice animals for the stock-judging exercises.

General problems of agricultural science and pedagogy were discussed at the inaugural exercises and at Saturday morning conferences. Among the topics thus treated were the history of agricultural education and research in the United States; the organization of agricultural education in colleges, secondary schools, nature-study courses, correspondence courses, farmers' institutes, and various forms of university extension; what constitutes a science of agriculture; methods and values of cooperative experiments. Through social assemblies, visits to typical Ohio farms, and much informal discussion wherever the students met each other, the educational influences of the school were greatly extended. Seventy-five students were in attendance. These were drawn from 28 States and Territories, including such widely separated regions as Maine, Oregon, California, New Mexico, and Alabama. There was one student from Canada and one from Argentina. There was also one woman, and the colored race was represented by teachers from the Tuskegee Institute and the agricultural college at Greensboro, N. C. Twenty-seven of the students are professors or assistant professors of agriculture in agricultural colleges, 31 are assistants in the agricultural colleges and experiment stations, 9 are recent college graduates, and 8 are engaged in farming.

Considering the character of the faculty and students, it goes without saying that the whole period of the session was occupied with the most earnest and profitable work. Without doubt the influence of this school will be felt throughout the country in the improvement of courses of instruction in agriculture and the strengthening of the lines and methods of investigation of agricultural subjects. In other ways the school will exert a beneficial influence. So rapid has been the accumulation of materials for a real science of agriculture during the past few years that even professional students of agriculture have not realized how large a mass of knowledge is already available for molding into a systematic body of truth which may be utilized for pedagogic purposes, as well as for inductions of scientific and practical value. The summaries given by the experts gathered at this graduate school have emphasized this fact and shown in a striking manner that agricultural education and research may now be properly and efficiently organized with reference to the science of agriculture itself, rather than be as heretofore very largely a matter of the sciences related to agriculture. This will serve to stimulate greatly the movement already begun for the reduction of the materials of agricultural science to "pedagogic form" for use in colleges and secondary schools, and for the reorganization of agricultural institutions of research on the basis of the divisions and subdivisions of agriculture instead of physics, chemistry, botany, and other primary and secondary sciences. The day will thus be hastened when the science of agriculture will rank as one of the great systems of knowledge of direct benefit to mankind.

Improvement of Rural Schools.

We are, without doubt, in this country just on the edge of a great popular movement for the improvement of the conditions of rural life through the improvement of the rural schools. As one phase of this movement there will come the broadening of the instruction in the principles of agriculture, so that in addition to college courses we shall have secondary courses in ordinary and special high schools, and even some elementary instruction in the common schools. In establishing the lines and methods of secondary and elementary instruction in agriculture so that it may be useful and attractive to the masses of our rural youth, the leaders in agricultural science gathered in the Graduate School of Agriculture this summer will play an important part, and it is believed that they have gone out from this school with much inspiration to renewed efforts in this direction. For both the thorough establishment of the science of agriculture and the wide popularization of this science, the new school will, it is believed, be an efficient agency, and I hope the way may open for it to become a permanent institution.

The Agricultural Colleges.

A number of the agricultural colleges have made considerable progress during the past year in strengthening and broadening their courses in agriculture. Specialists in agronomy, animal husbandry, soil physics, soil bacteriology, dairying, and other branches of the general subject of agriculture have been added to their faculties. This has made it possible to materially increase the number of different courses in agricultural subjects offered to their students. This is especially true of the short or special courses in agriculture for students who for one reason or another are not able to take the entire course leading to the bachelor's degree.

Statistics of attendance at the land-grant colleges for the year 1901 show that over 42,000 students were enrolled. This was an increase of nearly 7 per cent over the attendance for the previous year. The total attendance upon four-year courses in agriculture (including dairying) increased more than 26 per cent. The number of students in special courses has fallen off relatively, indicating a growing recognition of the greater value of the full collegiate course in agriculture as compared with specialization along narrow lines in undergraduate work.

During the past two years there has been a remarkable increase in the number of buildings erected at these colleges. It is estimated that during this period at least $2,000,000 have been spent by the States for this purpose. In these buildings there are not only improved facilities for instruction in the sciences related to agriculture, but also more particularly for the teaching of the different branches of the science of agriculture itself. The changes in equipment and in the organization of faculties have put college instruction in agriculture largely on a new basis. Since the new courses deal much more largely directly with agriculture, both as an art and a science, the students are not only well trained in the theory of agriculture, but are brought much more closely into sympathy and actual contact with the practice of the art. Each year the chasm which formerly existed between science and practice is being more strongly bridged. Stronger bonds of sympathy and effort are uniting scientists and farmers through the medium of the agricultural institutions. The colleges therefore not only occupy a better position in the educational world, but they are also more strongly intrenched in the confidence and support of the great masses of practical men.

Secondary and Elementary Schools of Agriculture.

Institutions for secondary and elementary instruction in agriculture are becoming more numerous. Schools of this class already established have been continued, new schools are being established, and courses of instruction in agriculture, nature study, and gardening are being introduced into existing public and private schools. The marked success of the agricultural high schools established in connection with the universities of Minnesota and Nebraska indicates that there is a demand for agricultural courses of parallel degree with those offered in various manual arts in our city high schools. Already there is a promising movement for the establishment of special agricultural high schools in different localities separate from the colleges, and some instruction in agriculture is now given in a number of normal and public high schools. Students taking such high-school courses would undoubtedly be able to better appreciate the work of this Department and the agricultural experiment stations and would have a better outlook regarding the movements of our times for the improvement of agriculture, which would enable them to become intelligent, progressive, and successful farmers. All over our country farmers are sending their children to public high schools and paying tuition for their instruction. They have, therefore, good reason to urge that courses on subjects related to agriculture should be introduced into these schools, especially in towns which are wholly or largely dependent on the neighboring farms for their commercial success, if not their very existence.

Since the funds expended in promoting technical education in agriculture are in the nature of investments which will be richly repaid in larger amounts of assessable farm property and the increased wealth that comes from improved farm products, both the States and the local communities can well afford to make liberal contributions to the support of courses in agriculture in the secondary schools as well as in the agricultural colleges.

Progress is also being made in the movement for the consolidation of rural schools which has already resulted in improved conditions in the schools of Ohio, Massachusetts, Iowa, and other States. Such consolidation makes it possible to introduce nature study in which matters pertaining to agriculture, horticulture, and domestic arts are easily included. Several States have already passed laws requiring teachers to prepare themselves to give instruction in nature study and agriculture, and exercises and illustrative material for such work are being more frequently published, often with the aid of the teachers in the agricultural colleges.

Another closely allied movement at present manifest principally in the city schools is the school-garden movement—the introduction of garden work with flowers and vegetables into the graded schools as a weekly or semiweekly exercise. Wherever work of this kind has been tried under proper supervision it has aroused considerable interest on the part of the students, has furnished excellent material for nature-study work, and has correlated well with the other studies in the curriculum.

Farmers' Institutes.

In my last annual report I recommended that an appropriation of $5,000 be given to enable the Office of Experiment Stations to undertake work connected with the promotion of the farmers' institute system in this country. The appropriation was to be used in employing an officer who would devote his time and energy to this work, visit institute workers and advise them regarding the ways in which the Department might help the institutes, study the problems of institute management at home and abroad, and seek to shape the Department's work for the institutes so that it might be most helpful to this enterprise. As the matter was finally fixed in the appropriation act, only about $2,000 of the income of the Office of Experiment Stations for the current fiscal year can be used for this purpose. This is entirely inadequate for the work planned, but will be used in gathering statistics of the institute movement and in employing, during a part of the year, an officer who will be retained as farmers' institute specialist, if Congress shall provide sufficient means for continuing the work.

Farmers' institutes are now held in 44 States and Territories, including Hawaii. Nearly complete returns from 40 States and Territories show that in the areas reported about 2,300 institutes are held annually; that the funds expended by the different States and Territories in support of these institutes (not including expenses incurred by local authorities) amounted to about $196,000 per annum, and that about 709,000 people attended the institutes. The number of students taking the agricultural course at the agricultural colleges in the same States and Territories during the year ended June 30, 1901, was 9,623, including those who are recorded as attending courses in household economy, dairying, and veterinary science.

The total number of persons reached by the farmers' institutes and the agricultural colleges (about 720,000) is, however, only a small percentage (7.2 per cent) of those actually engaged in agricultural pursuits (about 10,000,000). The publications of the experiment stations are sent to about 500,000 farmers. A great need of our educational system is, therefore, wider dissemination of the results of agricultural study and research among those now actually engaged in farming.

I recommend that an appropriation of $6,000 be made by Congress to enable the Office of Experiment Stations to aid the farmers' institutes during the fiscal year 1904.

Experiment Stations in Alaska.

Agricultural experiment stations were maintained during the fiscal year 1902 at Sitka, Kenai, and Rampart. The experimental work has included the growing of cereals and vegetables, methods of reclamation, drainage, and fertilization of land, and the curing and ensiling of forage crops. In all these lines successful results were obtained, and much information which will be of use to persons attempting agriculture in Alaska was acquired. The survey of different portions of Alaska with reference to their agricultural possibilities was continued. The special agent in charge made a journey through a large portion of the Yukon River Valley. A reconnoissance of the Copper River regions and portions of the Fortymile country and the Tanana River Valley was made during September, 1901, by the assistant who had been in charge of the station work at Rampart. He estimated that in the region covered by his journey there was some 2,000,000 acres of land suitable for farming and pasture. Grass grew abundantly and luxuriantly in large regions.

The distribution of seed of hardy varieties of vegetables, cereals, and grasses has been continued and extended, seed for use the present season having been sent to some 750 addresses. Many reports of trials of seed previously sent have been received, and in this way much useful information has been secured. It is evident that the efforts made by the Department to aid the residents of Alaska in their agricultural work by distributing improved varieties of seeds have produced beneficial results. Not only has this been of advantage to the white population, but the natives also are learning to cultivate gardens, and it is reliably reported that there is a large increase in the number of natives who attempt to cultivate small patches of ground.

The equipment of the stations in Alaska has been increased by the erection of a barn, cottage, and small blacksmith shop at Sitka and the completion of a small station building at Kenai. During the present year a beginning will be made of establishing a nursery of hardy fruits at Sitka. Only a limited amount of work in this line can be done until a horticulturist is added to the station staff. It is also planned to secure a small flock of Angora goats, with a view to ascertaining whether these animals can be successfully reared in the coast region of southern Alaska. The plants naturally growing in this region will furnish abundant forage for goats. The work at Kenai will be continued and similar operations will be carried on at Rampart and Wood Island and in the Copper River region.

It is hoped to complete the headquarters building at Sitka during the present year. The cost of this work will be about $2,000. As soon as possible a small herd of cattle should be placed at the Kenai station and experimental work in animal husbandry begun. This would involve the building of a barn there and the employment of additional laborers. The station at Sitka should have an equipment of chemical apparatus sufficient for simple chemical work.

As long as the income of the stations is on the present basis it will not be possible to do more than maintain the stations at Sitka and Kenai and do a very limited amount of work at one or two places in the interior.

HAWAII EXPERIMENT STATION.

A large amount of work has been done at the Hawaii experiment station during the past year in clearing and preparing for cultivation portions of the tract reserved for the station and establishing plantations of fruit and other valuable trees and experimental plats. The buildings begun the previous year were completed, and the station now possesses a residence for the special agent in charge, an office and laboratory, stable, cottages for laborers, water tanks, etc.

Experiments have been begun with potatoes and taro to overcome the very destructive diseases which seem to threaten the extinction of these crops. Taro forms the principal food of the Hawaiians, and the ravages of the blight have so curtailed the supply that there has been actual suffering in some places because of the shortage. At present the experiments are being confined to the lowland taro, and an effort is being made to find some remedy for the disease that attacks the root. Dry-land taro does not appear to be as susceptible to disease, but it will be studied also. It was found in many cases that immature and diseased cuttings were used for planting. The lowland form of taro requires extensive irrigation, and in practice the land is kept flooded for a considerable time. Wherever the water was allowed to become stagnant it was found that the root rot was most prevalent. By the use of fertilizers it was found possible to actively stimulate the growth of the plant and make it less liable to disease. Wherever a liberal application of lime was made there was no disease, and with care in the management of the water, selection of cuttings, rotation of crops, use of lime and fertilizers it was found possible to not only reduce the disease, but to considerably increase the production of the crop.

The experiments with potatoes were conducted upon the island of Maui in cooperation with one of the residents of that island. This island formerly produced the most of the potatoes grown in the archipelago. A disease locally known as black rot has for ten or more years been seriously depreciating the crop. This, as has been determined by the station authorities, is due to a soil fungus, and experiments are being undertaken to combat it. In the field investigations 45 varieties of potatoes were grown under similar conditions, and marked differences were noted in the susceptibility of the varieties to disease. This work is to be followed up in the hope that some sorts may be found which are nearly or quite resistant to disease.

Investigations were begun on the diseases of poultry, and a bulletin was issued in which suggestions were given for the care of fowls and treatment of the diseases to which they are especially subject, and as a result of which poultry and eggs are excessively expensive in the Hawaiian markets.

Attention has also been given to fiber plants, mangoes, the castor bean, pineapples, peppers, and rubber and cork oak trees, and other plants believed worthy of investigation and development. A study has also been made regarding the use of pumps for irrigation purposes in the Hawaiian Islands, where the pumping of water for this purpose has in all probability reached its highest development. Members of the station staff have visited other islands of the group and an attempt has been made to get into touch with all the agricultural communities. Farmers' institutes are being organized under the auspices of the station. Bulletins on chickens and their diseases and on taro have been prepared and others are in course of preparation. It is clear that there is a wide field for agricultural investigations in this Territory. Owing to local conditions of soil, temperature, rainfall, and other natural conditions, the station will be obliged to do much work in different localities.

The presence of enormous numbers of destructive insects is one of the chief obstacles to agriculture in Hawaii. The land areas are small and the uniformity of seasonal temperatures presents no check to the development of insects which may have been introduced from continental regions. As a result the insects speedily lose their distinctive habits. Many of the introduced species no longer have a definite life period, but breed at all seasons and are practically in continuous existence throughout the year, swarm following swarm, with no intervening period when the land is free from their ravages.

There are a number of serious fungous diseases of plants which require investigation, both because of the local losses caused by them and on account of the possibility of their being carried to other parts of the islands. The work on the taro rot and the Fusarium disease of the potato will need to be continued for several years.

There are many problems of both scientific and practical interest which require the services of a chemist. Soil and water analyses, the study of the rôle of mineral nutrients in plants and soils, the composition of Hawaiian foods and feeding material all should be given attention. Investigations should be made as the occasion requires of other agricultural products which may lead to the establishment of local industries, such as fiber plants, tans, dyestuffs, rubber, vanilla, coffee, tobacco, silk, fruits, and vegetables.

Considering the numerous agricultural problems requiring investigation in the Territory of Hawaii, the experiment station there should have added to the station force a chemist; the apparatus and other equipment should also be increased, and provision made for the printing and distribution of station publications.

Porto Rico Experiment Station.

The agricultural experiment station in Porto Rico is now established on a permanent basis. This result has been secured through the cooperation of the insular government and legislature. A bill appropriating $15,000 for the purchase of a suitable tract of land for the station was passed in February, 1902. Under this law bids were called for which were closed the 12th of May. The result of these negotiations was the purchase of approximately 230 acres of land adjacent to the city of Mayaguez. The land is varied in character and well located with reference to the city. It gives promise of making a very desirable site on which to carry out the objects of the experiment station.

On this tract it is proposed to begin field tests of leguminous crops, grasses, corn, rice, beans, and vegetables. A nursery and orchard of tropical fruits, including those grown on the island, and promising varieties from other countries will be established for experimental purposes. With the temporary experiments undertaken last year much useful information has been obtained regarding soil and climatic conditions as related to the growth of crops in the island. An important study has also been made of the Changa, a mole cricket, which is the most injurious insect of the island, and a bulletin regarding this insect will soon be published in both Spanish and English for distribution in Porto Rico. Experiments looking toward the improvement of coffee, now grown so largely in the island, have already been well begun, and it is proposed to extend them materially during the coming year.

It is important that the Porto Rico station should undertake experiments with live stock, but it will not be possible to do much in this direction unless the resources of the station are increased. Additional funds will be required for the employment of a competent live-stock expert, the purchase of animals, and the general expenses of feeding experiments. In order to effectively conduct experiments with fruits a horticulturist should be added to the station staff.

Now that the Porto Rico station is permanently located, it should, in my judgment, receive the same financial support from the National Treasury as is given to the stations organized under the act of Congress of March 2, 1887. Considering the large population to be maintained by agriculture in Porto Rico, every effort should be made to develop the agricultural resources of the island. The station will be called upon to aid in the solution of a great variety of problems. The range and effectiveness of its work will necessarily be limited by the funds at its command. When the nation does as much for the Porto Rico station as for stations in the other States and Territories, there will still be need for additional financial assistance from the insular government. The cordial support which has been given the station by the Government and the substantial grant of money voted by the insular legislature for the purchase of land for the station have given evidence that the people and government of Porto Rico appreciate the importance of this enterprise and are willing to supplement the efforts of the National Government in this direction. As the work of the station develops, additional buildings and equipment will be needed, and it is confidently expected that these requirements will be met by the local legislature.

Nutrition Investigations.

The nutrition investigations have been continued along the same lines as heretofore, including dietary studies, and digestion, cooking, and metabolism experiments. These studies have been carried on in cooperation with universities and experiment stations in Maine, Massachusetts, Connecticut, New York, Tennessee, Illinois, California, Minnesota, Vermont, and Georgia. The respiration calorimeter used in these investigations has been improved, and the studies during the past year with this apparatus have had reference especially to the relative efficiency of fats and carbohydrates as sources of energy for the performance of muscular work. To further study the relation of diet to muscular work, dietary studies with lumbermen performing severe work in the forests of Maine have been made. Among other subjects of investigation have been the digestibility and nutritive value of bread made from different kinds of flour; the effect of cooking on the nutritive value and digestibility of different kinds and cuts of meat; the relative nutritive value of different kinds and combinations of fruits and nuts, and the comparative metabolism of nitrogen, sulphur, and phosphorus. Five bulletins regarding the results of nutrition investigations were published during the past year. Special efforts have been continued to bring the results of this work to the attention of schools and colleges, physicians, scientists, superintendents of public institutions, persons engaged in philanthropic enterprises, etc.

At the summer school of nutrition and bacteriology, held at Wesleyan University, Middletown, Conn., in July, 1902, under the direction of the special agent in charge of nutrition investigations in connection with his work as professor in that institution, the methods and results of the nutrition investigations of this Department were explained to a considerable number of teachers of domestic science from different regions, and others who have engaged to a greater or less extent in the teaching of nutrition, bacteriology, and kindred subjects in the agricultural colleges and other institutions.

As stated in my previous report, it is very desirable to extend the nutrition investigations through a systematic study of dietaries in public institutions. Plans for beginning this work have already been made and considerable material, including summaries of results of early investigations, has been collected. Through an arrangement with Dr. A. B. Richardson, superintendent of the Government Hospital for the Insane in the District of Columbia, dietary studies will be made in that institution during the current year in accordance with plans furnished by this Office.

In early times the idea was prevalent that the diet of prisoners and other delinquent classes should be so poor and inadequate that it constituted a punitive measure. This is now recognized as wrong, and most civilized nations endeavor to feed such persons adequately. The food requirements obviously vary with the amount of work performed, and in most cases it is essential that the cost of the food be moderate. Food investigations are required in prisons and other institutions in order that satisfactory dietary standards may be formulated, and also to compare the rations actually fed with proposed standards. The importance of such studies has been often recognized in the past; for instance, under the authority of the institutions' commissioner in Boston, Mass., dietary investigations were carried on in a number of reformatories, etc., in that city. Studies have also been made at the reformatory at Elmira, N. Y., some of which had the special object of determining whether it was possible to favorably affect the moral welfare of inmates through their diet.

Under special government authority the diet in Scotch prisons has been recently studied, and mention may also be made of recent work of a similar nature in Berlin. In many cases it has been found that it is possible to furnish a more satisfactory diet and at the same time diminish the cost.

Nutrition investigations have also been made in almshouses, orphan asylums, and similar charitable institutions in times past in this and other countries—Germany having taken the lead. The importance of providing a proper diet for inmates of such institutions has received government recognition in Great Britain, and investigations bearing on the subject have been undertaken there. An adequate diet should unquestionably be supplied to all who are dependent on charity of this sort. The numerous studies which have been made show that with proper care good food may be provided at a reasonable cost. While the diet in many institutions is undoubtedly satisfactory as regards kind and cost, it is not too much to say that in very many others dietary studies would show the possibility of diminishing the cost and at the same time improving the quality. The benefit to the inmates and saving of public money in this way seem worthy of all possible effort.

In previous reports I have called attention to the fact that investigations were needed to determine the food habits and requirements of residents of tropical countries. This matter is becoming of increasing importance, owing to the continuance of soldiers, sailors, and civil officers of the United States in such regions. This, and the fact that large numbers of our people are called to tropical regions by our rapidly extending commerce, would seem to justify the institution of such investigations to determine the most suitable diet under the new climatic conditions. It is well known that a suitable diet is a matter which has a great effect upon the maintenance of good health of old residents in tropical countries, and is even more important for recent arrivals. The U. S. Army has devoted considerable attention to this subject, as have also German, British, and other European investigators, generally under the auspices of the army or navy of their respective Governments. The lack of agreement regarding the diet best suited to residents of the Tropics shows that more extended investigations are required.

The economic feeding of troops and other residents in tropical regions obviously depends in some measure upon the utilization of local food products. Many of these products are comparatively unknown outside the Tropics, and their food value has never been studied.

IRRIGATION INVESTIGATIONS.

Two causes have operated during the past year to increase the interest in the Department's work for irrigated agriculture. One was the desire of the arid States for the creation of conditions which will result in the largest and best use of the water supply, and the other the drought which prevailed throughout the Middle West in 1901 and in the South during 1901 and the present year. As a result of this interest, requests for information and advice have been far more numerous than ever before, and it is only through the increased appropriation made by the last Congress and the better organization of the work that these demands have been met.

The distribution and use of Western rivers require that the irrigation industry shall be organized, and in order to provide for this it is necessary that there be a better understanding of the subject than now exists. The first need is for the facts. We need to know how much water is being used, where it is being used, how much water is required for the maturing of crops, how it can be distributed with the least loss, and how applied to the best advantage. This information the Department is securing and disseminating through this investigation, and in doing this it has enlisted in its service many of the leading irrigation engineers and scientists of the arid States. The services of these men would have involved a prohibitory expense if it had been necessary to employ them continuously, but through cooperative arrangements with the State agricultural colleges and experiment stations and the State engineers' offices the scope of both local and national investigations has been broadened and made more effective, while the outlay to each of the parties to these arrangements has been greatly reduced.

THE DISTRIBUTION AND USE OF WATER.

The Department is now making measurements of the water used in irrigation in all of the arid States but one and in a number of humid States. The results of these studies during the past three years, while not conclusive, have already done much to educate farmers and ditch managers as to the direction from which improvements of methods and practices must come. They have made plain the need of better work in constructing and maintaining canals. They have shown that the water lost through leakage in transit is far greater than has been generally supposed, and that its loss causes a double injury. It returns in many instances to the surface of lower-lying fields and converts productive areas into unsightly swamps and marshes, rendering them for the time practically worthless. The loss of water through evaporation from these submerged areas is large. If this could be prevented and the water saved applied to crops it would largely increase the cultivated area. One of the leading lines of work of these investigations will therefore be a more careful study of losses from seepage, in order to determine measures by which this can be lessened.

In a number of instances these studies have led to careful inquiries by canal owners to determine whether or not it will be profitable to cement the main ditches and canals, and to requests for further assistance from this investigation to determine how this may be done to the best advantage. The Report of Irrigation Investigations for 1901 will give the methods pursued and the cost of cementing one of the principal canals of southern California.

DRAINAGE SURVEYS.

In response to numerously signed petitions from the agricultural and horticultural interests of the valley of Kings River, in California, the Department has carried on a comprehensive drainage survey to determine what plans can be best adopted for relief of the overwatered lands of that section. This work has been under the direction of Prof. O. V. P. Stout, of the University of Nebraska, and the report, which is now approaching completion, will give the plans and estimates for two methods of removing the surplus water and making it available for use elsewhere. The carrying out of these plans will probably require additional legislation on the part of the State, and a local committee has been formed to frame bills and promote the enactment of needed laws.

At the request of the Hon. A. J. McCune, State engineer of Colorado, the Department has assisted in the investigation of the drainage problems of that State. This work is under the direction of C. G. Elliott, a drainage engineer of wide experience. The information already gained makes it certain that these studies are to be worth many times their cost, both to the localities where they have been carried on and in their influence on the larger and better use of the water supply. Some fears have been expressed that the water coming from these drains would be unfit for use because of the large percentage of alkali it contained, but analyses made by the State experiment stations of Colorado and California have shown that this is not the case.

STUDIES OF IRRIGATION LAWS.

The larger problems which the complete use of Western rivers is destined to create and the measure of public control which recent irrigation legislation renders inevitable gives added interest to the Department's studies of the legal and economic phases of irrigation. The division of the water of streams among farms scattered for hundreds of miles along their courses, so that each acre cultivated shall receive its just share of the common water supply, is one of the most complex administrative problems which confronts Western agriculture, and the establishment of titles to these streams by methods which shall prevent speculative appropriations of water and the creation of water monopolies is one of the imperative needs of the immediate future.

The larger opportunities which national aid affords should awaken the civic pride of the States benefited in seeing to it that not only in material development but in their institutions the irrigation systems of this country rank among the foremost of the world.

A beginning of the studies of the conditions and experiences of other lands was made during the past year. Mr. C. T. Johnston, assistant chief of these investigations, visited Egypt for this purpose. Through the courtesy of Government officials he was enabled to become fully acquainted with the administration of the laws which govern the use of the Nile, and his report will show the character of the rights to water recognized and the manner in which these rights are enforced in times of scarcity. While differences in conditions will doubtless prevent the adoption of many of the methods pursued, the lesson of one of the oldest irrigated countries in the world can not fail to be of great interest and value to one of the youngest. In addition, Mr. Johnston's report will present many matters of practical information regarding the size and construction of canals, the manner in which water is distributed and applied to crops, and the yield and value of the products.

A number of the arid States are cooperating with the Department in these studies of sociological and legal problems. Montana and Nevada appropriated money for such studies, and the irrigation officials of Wyoming, Colorado, and Idaho have given both personal and official aid. No branch of the Department's irrigation work has received more cordial recognition than its studies of legal and sociological questions, and it is believed that they are destined to exert a beneficent influence on the future industrial life of the West.

IRRIGATION IN THE HUMID STATES.

The development of the rice industry in Louisiana and Texas has had the effect of enormously increasing the value of land hitherto used only for grazing purposes or not at all. Its success has led to the investment of large sums of money and a marked increase in the population. In the amount of money invested in canals and pumping plants and in the increase in the acreage reclaimed, the rice districts of Louisiana and Texas have made as great progress during the past two or three years as any of the irrigated districts of the West. This rapid growth has given rise to a number of practical problems in which the aid of the Department has been invoked.

Establishing and maintaining pumping plants requires a knowledge of the amount of water required, the cost of furnishing it, and the methods by which waste in use may be reduced to the minimum. The light rainfall of the past two seasons has also made it manifest that the time is not far distant when there will be need for establishing rights to the use of streams and some division of their water supply among these irrigators. During the present season the rainfall from June to September was little more than that of many of the arid States, and this, combined with the large increase in the irrigated acreage, has made the drain on some streams cause their current to be reversed and salt water to flow in from the Gulf.

The growth of irrigation in the Southern States is not, however, confined to the rice districts. During the past year the experts of this investigation have furnished information and advice to farmers in Georgia, Alabama, and the Carolinas under which a number of irrigation systems have been installed. The drought of the present season has made the first year's trial a marked success, but it will require a number of years to determine to what extent irrigation can be profitably employed in this section. The fact that the Department was able to answer these inquiries has saved large sums of money to individual farmers. In nearly every instance they had planned to put in pumps of too small capacity to have been of any real service, and the attempts would have resulted in disappointment and loss and probably have delayed adoption of what promises to be an important aid to both agriculture and horticulture.

The cooperative irrigation studies undertaken in connection with the State experiment stations of Wisconsin, Missouri, and New Jersey have been continued, the object being to determine how far and by what method irrigation can be profitably employed in the humid States.

In view of the increased interest in the questions with which the irrigation investigations of this Department deal, growing out of the rapid development of our irrigation system under private as well as public auspices, there is constantly enlarging demand for the services of our irrigation experts and for the published results of their investigations.

Agricultural Engineering.

In order to answer the inquiries received by the Department and to make the irrigation investigations of the greatest practical benefit, it has been necessary to include studies of the applications of power whose relation to irrigation is made apparent only by a thorough understanding of existing conditions. Farmers under irrigation apply to the Department for information regarding the use of streams and canals for power purposes. Many who desire to irrigate small tracts apply to the Department for information as to whether or not pumping will pay, the kind of pumps to be used, and the amount of water required. Inquiries are received as to the relative economy of different forms of power, and whether coal, oil, gas, electricity, or wind power will best serve the irrigator's purposes. These questions should be answered because nothing is more wasteful than to have each man learn experimentally for himself what has been found out elsewhere, but the attempt to do this has made agricultural engineering an important feature of these investigations, and raises the question whether the usefulness of the work of this Department can not be materially augmented by entering upon a systematic study of agricultural engineering as related to the interests of all our farmers.

The possibilities of this subject can be illustrated by the one item of farm machinery. In the past twenty years the capital invested in the manufacture of agricultural implements has increased from sixty to one hundred and fifty-seven millions, and the value of the product has more than doubled, but more significant than this increase in its importance have been the changes in its character. Leaving out of consideration the larger and more important classes of farm machinery, such as reapers, mowers, and thrashers, which are usually thought of as supporting the claim that American inventive genius and mechanical skill have surpassed the world in constructing farm machinery, and taking up machines and implements but little thought of in this connection, it will be seen that the changes wrought in the past twenty years have been little less than revolutionary, and have been an important factor in maintaining our commercial supremacy. The invention of the disk harrow to supplement the types formerly used, the invention of the disk plow to compete with the types in use for centuries, the still more recent invention of corn-harvesting machinery, all serve to show the rapidity and radical character of the evolution which is now going on.

These facts, in connection with the increasing demand for efficient labor-saving devices resulting from the growing scarcity of farm labor and the organization and development in foreign countries of institutions for the systematic study and improvement of farm machinery, renders it important that we should not longer neglect this field of inquiry. There is an excellent opportunity for the Department to do an important service in promoting the continuance of our agricultural supremacy through the use of farm machinery by investigations regarding the fundamental principles on which the further improvement of such machinery must depend.

At present the Department is not in a position to answer the numerous requests for information on these subjects, and these demands will undoubtedly increase with the growing application of new forms of power to farm work and the development of new kinds of labor-saving machinery. The agricultural colleges and experiment stations throughout the country are beginning to realize the need of such studies, but they find great difficulty in establishing the work on an efficient basis owing to the lack of definite information in available form. It is believed that this Department should undertake to collate and publish such information, as well as to institute investigations which will keep the farmers and manufacturers of the country informed of the progress being made and show them the lines in which it may be extended.

Investigations in agricultural engineering should also include problems relating to the laying out of farms, such as the arrangement of buildings, drains, water supply, and disposal of sewage. The character of the agriculture of the twentieth century has made farm buildings as complex in design and varied in use as factories, and there is a wide field of study for improvement in design and for determination of the best material to be used in their construction.

The breeders of high-bred and valuable live stock need to give almost as much attention to stable sanitation as is given to house sanitation, but the data on which to plan efficient systems of ventilation are of the most limited character. It is believed that careful studies of the designing of farm buildings will be a benefit to agriculture, not only in saving large sums of money in the selection and combination of material used, but in the adoption of more convenient and effective plans.

NEED OF ADEQUATE FUNDS.

This review of the work of the Office of Experiment Stations in all its phases shows very conclusively the necessity for more liberal appropriations, as submitted in my estimates for the ensuing year, for carrying on the several lines of work assigned to the Office of Experiment Stations. It is particularly desirable that the stations in Alaska, in Hawaii, and in Porto Rico, which are under the direct supervision of the Secretary of Agriculture, should be as liberally dealt with in this respect as are the stations in the several States and Territories of the Union.

DIVISION OF FOREIGN MARKETS.

Investigations made by the Division of Foreign Markets regarding the status of our agricultural export trade in the principal markets of the world disclose an exceptional activity on the part of some of our most formidable competitors for that trade, and particularly such countries as Australia, Canada, and Argentina. These progressive exporting countries have within the last few years been taking exceedingly active measures for the extension of their foreign business. As was pointed out in a publication recently issued by the Division on the subject of the British agricultural import trade, about two-thirds of the farm produce required by the British people to supplement their domestic supply is now being purchased from the various competitors of the United States. The success of these competing countries suggests the importance of constant watchfulness in the interests of our own export business.

AGRICULTURAL EXPORTS IN 1902.

Statistics recently prepared by this Division show that the agricultural exports of the United States for the fiscal year 1902 had a value of about $860,000,000. In comparison with the record-breaking figures of the preceding year, the value for 1902 exhibits a rather marked decline. Next to the exceptional record for 1901, however, it is the largest ever reported, being decidedly above the average of the decade.

The decline from the high mark reached by our agricultural exports in 1901 was principally due to the fact that a serious shortage in the corn crop left a comparatively small supply of this important export grain available for shipment to foreign markets. Our exports of corn during 1902 amounted in value to only $16,000,000, while in 1901 we sent abroad consignments worth nearly $83,000,000. The loss to our trade through the diminished shipments of this product alone exceeded $66,000,000.

Aside from the extraordinary falling off in corn exportation, the most noticeable instance of decline occurred in the shipment of cotton. Our cotton exports for 1902 had a value of $292,000,000, or about $23,000,000 less than the figures recorded in 1901, when there were shipments worth $315,000,000.

Trade in Forestry Products.

The more active interest recently aroused in the question of forestry in the United States has created a larger demand for statistical information regarding our commerce in forestry products. To meet this demand the office devoted considerable time during the year to the preparation of statistics on the subject.

Last year the United States exported nearly $50,000,000 worth of forest products. Lumber in its various forms, not including heavy timber, comprised the principal item, the shipments under this head having a value of about $26,000,000. The exports of heavy timber, sawed, hewn, or in logs, were valued at about $10,000,000. Wood pulp and the minor products of the forest together formed an item of about $13,000,000.

Europe furnishes the principal foreign markets for American lumber. The United Kingdom is decidedly the largest purchaser, but extensive sales are also made each year to France and to Germany. Markets for our lumber, however, are found in nearly every quarter of the world. The neighboring countries of Canada and Mexico make considerable purchases. A promising market is now being developed on the island of Cuba, where in 1902 consignments worth over $1,000,000 were received. During the last few years a considerable export business in lumber has been established with the Philippine Islands. In 1902 shipments valued at $246,000 found a sale there. These islands, although rich in tropical hard woods, promise to afford an extensive market for the building lumber supplied so abundantly by the great timber districts of our Pacific slope region. Additional markets for that region will undoubtedly also be developed in other parts of the Orient.

Notwithstanding the immense timber areas of the United States, a larger sum is annually expended in the importation of forest products than is received in payment for such products exported. This is because of our extensive requirements as regards certain articles yielded only by the forests of the Tropics. It is quite probable that before many years the island possessions of the United States, and particularly the Philippine Islands, will supply a large part of the tropical forest products we are now obliged to import from foreign sources.

Trade with Island Possessions.

In view of the lively interest that is taken in the course of trade between the United States and the several island possessions, the office recently prepared some statistics to show the status, so far as products of agriculture are concerned, of our commerce during the past fiscal year with Hawaii, Porto Rico, and the Philippines. From the statistics in question it appeared that, while our agricultural trade with Hawaii suffered a rather marked decline in 1902, there was a considerable increase in the amount of such business carried on with Porto Rico and with the Philippine Islands.

OFFICE OF PUBLIC ROAD INQUIRIES.

The work of this office has been prosecuted along the same general lines as heretofore, but its practical features have been enlarged. Object lesson and experimental road work have received more attention than ever before, and efforts along this line appear to be doing much to stimulate the building of better highways in many sections. Practical work in the testing of road materials has also been continued and enlarged. The field work of the Director, his assistant, and several road experts and special agents who attend and address conventions, consult with and advise road officials, and come in personal contact with the people of many communities, is another important feature of the practical work of the office which is producing excellent results.

Cooperation in Object-Lesson Road Work.

The building of object-lesson and experimental roads has during the past year assumed a position of higher importance than ever before in the work of the office. Most of this work during the past year has been done in cooperation with several forces, each having a special interest in the improvement of the public highways. The first of these cooperating forces, the National Good Roads Association, was organized by public-spirited citizens to promote, by agitation and organization, the improvement of the public roads. Its work is educational in character, and one of its aims is to organize State and district associations. The second of these forces, the manufacturers of road-building machinery, contributes to the cooperative work the use of machines for building sample roads as well as experts to operate and explain this machinery. The third, one or another of the great railroad corporations, contributes the use of a train, popularly known as a "good-roads train," to carry from place to place along its lines the machinery and the representatives of all the cooperating forces. In this work the railroad corporations are actuated by a desire to develop the country tributary to their lines, particularly to secure the improvement of the roads over which commodities must be hauled to and from their stations. The Office of Public Road Inquiries of the Department constitutes the fourth cooperator. Its work is advisory, supervisory, and educational. The people of the various communities in which conventions are held and sample roads built may be mentioned as a fifth cooperating force, and a very important one, since it is not only the principal recipient of the benefits, but must furnish the money, the materials, the common labor, and the horsepower needed in building the object-lesson roads.

The character of this cooperative work can best be indicated by briefly describing the work done in the South during the past autumn, winter, and spring. In October, 1901, the Southern Railway Company fitted up a good-roads train, consisting of a locomotive and 12 cars, which carried the representatives of all the cooperating forces and the road-building machinery furnished by five of the principal concerns that manufacture such machinery in the United States. The itinerary of this train extended through six States—Virginia, North and South Carolina, Tennessee, Alabama, and Georgia—and covered a distance of 4,037 miles, the whole campaign occupying over five months. Stops of a week or more were made at eighteen different places, at each of which a road convention was held and object-lesson and experimental road work was done.

This practical work included the improvement of earth roads, the building of gravel, chert, shell, sand-and-clay, and macadam roads, the object being to utilize local materials wherever possible and to illustrate the best methods of using them. Many thousands of people attended the sessions of these conventions and took lessons in practical road work. Addresses were delivered by many men of prominence in political, educational, and religious fields, as well as by scientific and practical road builders and representative farmers. Permanent good roads associations were organized in every State visited. It is believed that the work done has aroused a deep and permanent interest in road improvement in the States visited, and has started a movement for better roads that will ultimately yield results of inestimable value to the South. Plans for work of similar character in several Northwestern States have been matured and will be carried out during the current year.

Aside from the cooperative work just described, the Office has done much sample-road work in cooperation with State and county officials, educational institutions, and experiment stations. In this way sample roads have been built in four States: Maryland, West Virginia, Ohio, and North Carolina.

The demand for object-lesson road work of the character indicated is very great and comes from all sections. The Office has been able to comply with only a small part of the numerous requests for its active participation in the building of sample roads. During the coming year work of this kind will be extended as greatly as the force and means of the Office will justify. It should be remembered that this object-lesson work costs the Department nothing except the salaries and expenses of its employees. In view of this fact and of its great practical value, the propriety of extending work of this kind seems apparent.

The road material laboratory is operated in collaboration with the Bureau of Chemistry, and its operations have already been discussed in connection with the work of that Bureau. The increasing demand for the services of this laboratory shows that its work is appreciated by practical road builders.

SPECIAL AGENTS.

The plan of dividing the whole country into four areas, known as the Eastern, Middle, Western, and Southern divisions, has been retained, but, owing to lack of funds, no special agents were appointed for the Eastern and Middle divisions. The special agents in the Western and Southern divisions have done a great deal of active field work, visiting different sections, attending and addressing conventions, collecting and disseminating information, and preparing and publishing matter on road subjects. It is expected that during the current year a special agent will be at work in each of the four divisions except the Eastern.

PUBLICATIONS.

EXTENT OF PUBLICATION WORK.

All the information acquired by this Department through its several bureaus and divisions by the means at its command finds its expression necessarily in the form of publications. The duty of issuing and distributing these publications is assigned to the Editor of the Department, under whose direction they are edited and prepared for the printer. The record of his work therefore accurately reflects the activity of the other Bureaus and Divisions of the Department. The statistics of publication work for the year, as reported by the editor, show that in no previous year since the organization of the Department has this manifestation of activity in all the branches of the Department work been so apparent.

The total number of documents issued during the fiscal year was 757, of which 85 were publications of the Weather Bureau, and the total number of printed pages of new matter edited and prepared for the printer by the Division of Publications was 18,184. Counting pages of new matter, the increase in the matter edited during the year was 25 per cent over 1901 and 75 per cent over 1900. In spite of this unprecedented increase, there were in the hands of the Public Printer on June 30, 1902—the closing day of the fiscal year—112 miscellaneous publications, not including 47 Farmers' Bulletins.

Farmers' Bulletins.

Of Farmers' Bulletins, four-fifths of which are by law set aside for the use of Senators, Representatives, and Delegates, there were printed 6,150,000 copies, of which the Congressional distribution absorbed 4,289,126. While Senators, Representatives, and Delegates have failed to avail themselves of the full number of Farmers' Bulletins allotted to them, on the other hand, the number at the disposal of the Department has been inadequate.

Growth in the Publication Work.

The growth in the publication work of the Department during the past decade has been phenomenal. Every enlargement of the scope of the work of any one bureau or division, or the adoption by the Department of any new line of investigation or inquiry, inevitably brings about an increase in the work of publication. The development of the Department itself can therefore be accurately traced in the records of the Division of Publications.

Ten years ago the total appropriations for printing for this Department, including the salary roll of the Editor and his assistants, were less than $100,000. The total number of publications was 210, and the aggregate number of copies issued was 2,689,084. Last year the total appropriations for the same purposes exceeded $380,000; the number of publications issued was 757, and the aggregate number of copies 10,586,580. This increase, amounting to nearly 300 per cent in appropriations and number of copies issued and to over 250 per cent in the number of publications, obviously supplies an accurate measure of the growth and development of the Department itself.

Cost of the Department Printing.

The amount appropriated for printing for the use of this Department is, however, far from being the total amount expended for the publication work of the Department. The Yearbook and several other reports issued annually are paid for by special appropriations, and no session of Congress passes without special provision being made for the publication of several important reports for which the regular printing appropriation is inadequate. The cost of the publication work of the Department thus does not fall short of $800,000 a year, to say nothing of the fact that this enormous mass of published matter is carried free through the mails to all parts of this country, to Canada, and to Mexico, at an expense to the Government which can not be less than $200,000 yearly at the least.

The diffusion of the information acquired by the Department, therefore, represents an annual expenditure of about $1,000,000, a comparatively small per cent of the amount required to defray the total expenses of the Department, but one, nevertheless, without which all the other expenses would be useless. A serious problem is presented by the fact that as the Department grows and becomes better known and its work more valuable and more highly appreciated, the demand for its publications increases even more rapidly than the supply, and with a constituency of over 10 000,000 workers on the 5,750,000 farms of the United States, of which probably not more than one-tenth are reached at present in anything like adequate measure by the publications of the Department, it is obvious that the demand upon us for published matter is bound to assume larger proportions, and, under the present system, to involve greater expense.

THE LIBRARY.

The work of the Department depends in a large measure upon an available collection of books relative to practical agriculture and to scientific experimentation at home and abroad. With this end in view the library has been increased from year to year until it now contains 75,000 volumes and pamphlets pertaining to the special lines of work carried on in the Department. As a working scientific library it is among the first, and as such is frequently made use of by scientists in distant parts of the country.

ACCESSIONS.

Each year some especially rare scientific works and many valuable sets of periodicals are added to the library, which are not available elsewhere in the country. With a larger appropriation more such works, in addition to current publications, could be procured to the great advantage of the public service.

The files of agricultural papers are particularly noteworthy, including representative publications from all parts of the world. This is one of the special collections most frequently consulted, and, in addition to its current value, it is a most important one as a source from which the progress of agriculture may be traced in future years. With few exceptions these publications are gifts from the publishers. Many gifts from scientific writers in the form of monographs and of reprints are also received, adding largely to the number and to the value of the annual accessions.

The most important source of accessions next to that by purchase is by exchange. The numerous publications of the Department are widely distributed to societies, universities, and other institutions of learning. In return for these, thousands of separate numbers of serial publications are received. The Library is the depository for all exchanges, that they may be systematically arranged and carefully preserved for the present and future benefit of the Department.

TECHNICAL WORK.

The card catalogue is kept up to date. The last appropriation provided for an additional cataloguer to further this branch of the work. In addition to the card catalogue, a volume entitled "Catalogue of the Works relating to Botany in the Department Library" has been published. It is expected that two such catalogues of books on special subjects in the Library will be issued each year until a complete subject catalogue is thus printed.

The accessions bulletins have been published quarterly, as heretofore. Two additional bulletins, containing works relating to botany and to irrigation, respectively, have also been printed. The card index to the publications of the Department has been continued. The number of sets of the cards has been increased to meet the demands for the index from depository libraries.

Serial publications constitute so large a part of the accessions to the Library that it is necessary to devote much time and money to binding, both for the preservation of the volumes and for convenience in their use. The past year 1,300 volumes have been bound, and although this is the largest number recorded for any one year, it could well be doubled with advantage to the Library if funds permitted.

ESTIMATES AND APPROPRIATIONS.

The estimates for the fiscal year ending June 30, 1903, which were prepared in the Division of Accounts and Disbursements, were submitted to Congress through the Secretary of the Treasury with an explanation of all changes from the appropriation of the preceding year. These estimates amounted to $4,789,540, or $872,120 more than the appropriation for 1902. The amount finally appropriated for 1903 was $4,503,960. These amounts are exclusive of the $720,000 appropriated for the agricultural experiment stations, and the general printing expenses.

The statutory rolls of the Department increased from $533,640 in 1902 to $630,760 in 1903. This does not represent an actual increase either of salaries or clerical force, but was the result of the transfer to the statutory rolls, on the recommendation of the Agricultural Committees of both the Senate and House of Representatives, of clerks who have heretofore been paid from the lump-sum rolls of the Department.

During 1902 $12,600 was paid for the rent of buildings in the District of Columbia, and the appropriation for the same purpose for 1903 is $21,700.

OFFICE OF THE APPOINTMENT CLERK.

The records of this office show that on July 1, 1902, the total number of employees in the United States Department of Agriculture was 3,789, of which 1,209 were executive officers and administrative assistants, clerks, messengers, and watchmen; 2,081 scientists and scientific assistants, and 499 laborers and charwomen.

During the fiscal year ended June 30, 1902, the appointments made on certificates of the United States Civil Service Commission numbered 305, including 10 reinstatements and 19 transfers from other Departments. Thirty-five persons declined appointment on civil-service certificates. There were 108 resignations, 22 removals, and 14 deaths.

EXPOSITION WORK.

The Department of Agriculture, in connection with other Departments of the Government, has, in compliance with the law, participated in various expositions in this and foreign countries; and it is now preparing an exhibit for the Louisiana Purchase Exposition which is expected to be the best ever made by the Department.

It is not intended to make this an exhibit of agricultural products and resources, differing in that respect from exhibits prepared for expositions in foreign countries, where an effort has always been made to exhibit the products and resources of the country in the hope of increasing our trade abroad. It is expected that the articles and material exhibited at St. Louis will illustrate as nearly as possible the workings of the various Bureaus and Divisions of the Department, giving to the people who may not have an opportunity to visit the Department a chance to see what it is doing to promote the agricultural interests of the country.

The preparation of the Department exhibit devolves upon the heads of the several bureaus and divisions, under the general direction of the Assistant Secretary, Hon. J. H. Brigham, the representative of the Department on the Government board, and who has served on several previous occasions in the like capacity.

Since the elevation of the Department of Agriculture to executive rank, the President has honored it by naming its representative as the chairman of the Government board at the various expositions.

MAGNITUDE OF AGRICULTURAL INDUSTRY.

In the industrial progress made by the United States during recent years there has been no more conspicuous feature than the growth of agriculture. It is doubtful if the magnitude attained by our farming interests is generally known. According to the reports of the Twelfth Census, the fixed capital of agriculture, comprising the value of the land, buildings, and improvements, of implements and machinery, and of live stock, amounted in 1900 to about 20 billions of dollars, or four times the fixed capital invested in manufactures. During that year there were nearly 5,740,000 farms in the United States, covering an area of 841 million acres, of which 415 million acres consisted of improved land. These farms had a total value of $16,675,000,000, exclusive of farming implements and live stock. Farm implements and machinery formed an item of 761 million dollars, while the value of the live stock on farms exceeded 3 billions of dollars.

As further indicating the importance of agriculture in the United States, it is a striking fact that, according to the returns of the last census, about 40 million people, or more than half of our total population in 1900, resided on farms. Of the 29 million persons comprising the portion of our population engaged in gainful occupations, about 10 million, or more than a third, were returned as employed in agricultural pursuits. The people that work upon the farm outnumber by more than 3 million persons those who are occupied in the manufacturing and mechanical pursuits.

In 1899, according to the census returns, the produce of American agriculture, including farm animals and their products, had an aggregate value of nearly 5 billion dollars. Some of the crop values that make up this total were almost startling in their size. The crop of indian corn, which formed the leading item, had a value of 828 million dollars. The hay and forage of the census year were worth 484 millions. Wheat, which ranks next to corn among our cereal crops, gave a return of 370 millions, while oats were produced to the value of 217 millions. Cotton, the great crop of the Southern States, was valued at 324 millions.

In addition to these foremost crops, there were numerous others yielding returns in value that ran into the millions. Live stock and their products formed an exceedingly important factor in the grand total. The animals sold and slaughtered during the year were valued at above 900 millions. The several products of the dairy—milk, butter, and cheese—comprised an item of 472 millions, while poultry and eggs together brought a return of over 281 millions.

As a result of the intelligent application of improved methods to American agriculture, the produce of our farms has enabled us to increase the volume of our exports every year. Products of agriculture form about two-thirds of our entire export trade. Last year the exports from the farm amounted to 860 millions of dollars. The science of agriculture is in rudimentary stages in all lands. The education of producers from the field, so long neglected, has recently been undertaken in earnest in the United States. Our Government is doing more for the farmer than all other nations combined. Results are justifying expenditures, and the future will still further show the value of science applied to the farm.

Respectfully submitted. JAMES WILSON, *Secretary.*

WASHINGTON, D. C., *November 29, 1902.*

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